Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

NOVEMBER, 1954

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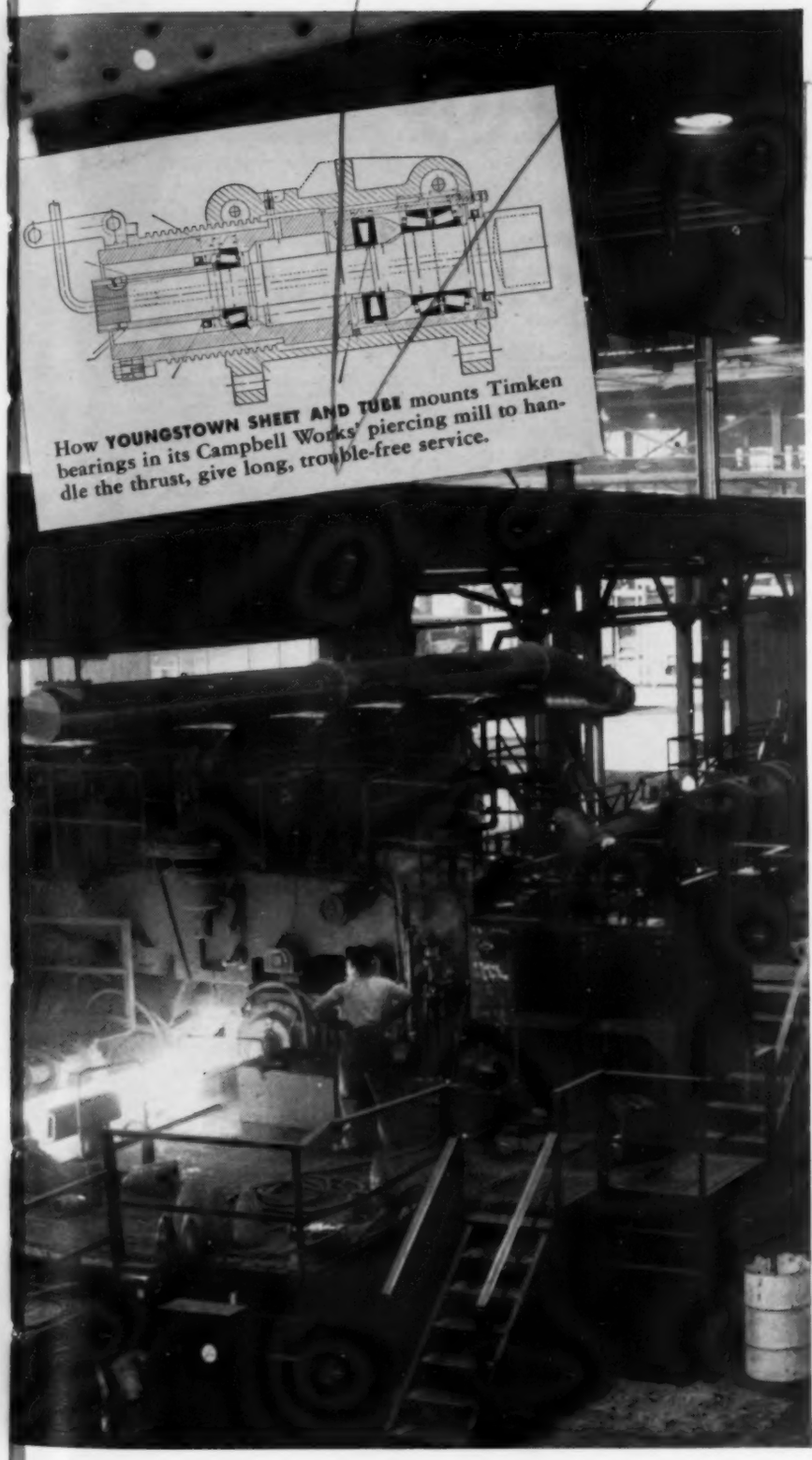


How **YOUNGSTOWN SHEET AND TUBE** mounts Timken bearings in its Campbell Works' piercing mill to handle the thrust, give long, trouble-free service.

Why TIMKEN® thrust bearings last longer

WHEN steel meets mandrel in the piercing mill at Youngstown Sheet and Tube Company's Campbell Works, the steel has to give. A Timken® thrust bearing takes the terrific pressure that's exerted on the mandrel. And Timken bearings in these thrust blocks can take it as proven by 20 years of continued use.

Full line contact between rollers and races is one reason Timken bearings stand up so well on this punishing job. It gives Timken bearings extra load-carrying capacity.

Another reason Timken bearings last and last is because rollers and races are case-hardened. This gives Timken bearings a hard, wear-resistant surface over a tough, shock-resistant core. And wear is reduced because the true rolling motion and incredibly smooth surface finish of Timken bearings practically eliminate friction.

Other Timken bearings in this application (see diagram) help handle some of the thrust. That's because the tapered design of Timken bearings enables them to take *any* combination of radial and thrust loads.

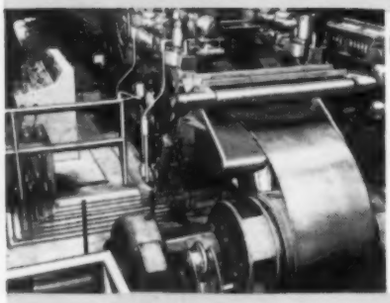
To get these advantages in the equipment you build or buy, always look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO". Canadian plant: St. Thomas, Ontario.

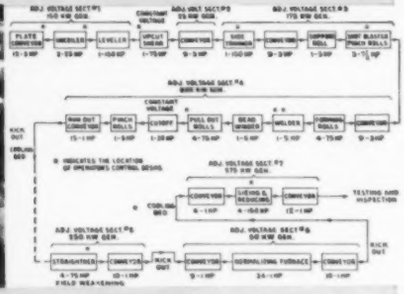
TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

NOT JUST A BALL ◯ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ↓ AND THRUST →◎← LOADS OR ANY COMBINATION →◎←

the Lone Star Steel *Achievement*★

Over 200 feet of 90″ high panels mount C-H Motor Control for Lone Star No. 1 Mill shown above.





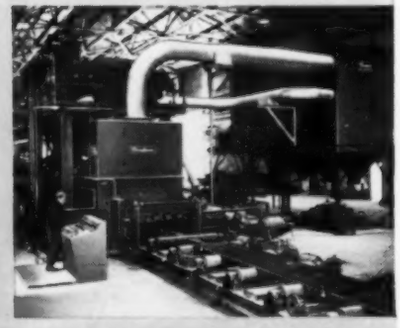
(At left above) Coiled skelp feeds from uncoiler into flattener.

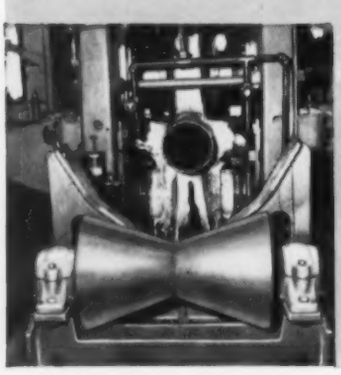
(At right above) Diagram shows sectionalization of Adj. Voltage Drives. AUTOMATION (closed loop control) is found in first 4 sections.

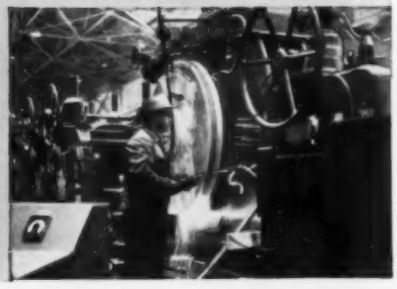
(At right) Blasting machine readies edges of plate for welding.

(At left below) Formed plate emerges from forming mill ready for welding.

(At right below) Largest resistance welder of its type. Wheel electrodes use ignitron contactors.







and the Name on the Motor Control

A gigantic machine is the Yoder Company's No. 1 Pipe Mill at Lone Star Steel. A machine continuously, automatically taking in skelp at one end and pushing it out at the other as completely finished pipe. Never before has pipe of this type from material of this character been continuously electric-weld produced. Never before, the experts agree, has it been possible. Yet fundamentally the individual machines that make up the integrated process are not new. What then is the secret? To a large extent it is found in the motor control that guides and integrates the hundreds of motors, the generators, exciters, alternators and machines on this line. And the secret of the motor control is the name found on that control . . . Cutler-Hammer, pioneer since 1892, constantly blazing new trails that enable machines, processes and mills to reach new highs in performance. Here is a store of experience such as you are likely to find nowhere else and always available to you—whether you plan a new mill installation or simply want to solve a present burdensome application problem.

Look to Cutler-Hammer for the simple, sure solution that means new efficiency, new dependability, new productiveness . . . an installation that goes right to work. Cutler-Hammer experience is as broad as it is long. CUTLER-HAMMER, Inc., 1269 St. Paul Avenue, Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

★ FIRST electric weld mill making J-55 casing from slit skelp . . . to use flying cutoff on 16″ pipe . . . completely conveyorized, automatic from skelp to finished pipe.

CUTLER·HAMMER
MOTOR CONTROL
C·H

LOOK TO CUTLER-HAMMER MILL EXPERIENCE...AS BROAD AS IT IS LONG

IRON AND STEEL ENGINEER: published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress, March 3, 1879 $7.50 per year in United States and Canada, $10.00 foreign countries. Volume 31, No. 11

THIS IS AETNA-STANDARD

SEAMLESS TUBE MILLS

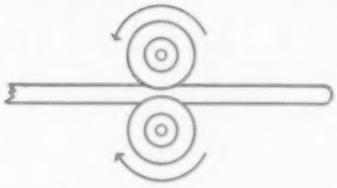
Aetna continues to conceive many new ideas for the production of seamless tubing. This continued progress, plus reputation and experience, helps Aetna-Standard to continue as world's leading designer and builder of Seamless Tube Mills.

ROLLS

Aetna specializes in manufacture of small and medium-sized iron-base rolls. Aetna is pioneering in the use of Nodular Iron for rolls and castings under trade name of Magaloy.

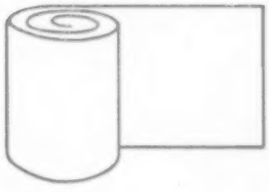
FLAT-ROLLED FINISHING EQUIPMENT

This is one of Aetna's six major product lines. Flat-rolled embraces such equipment as: Shearing and Classifying; Scrubbing and Drying; Recoiling; Slitting and Side Trimming; Roller Levellers (two-high and four-high); Reels of all kinds; and many other products.



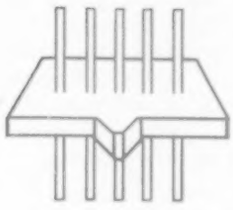
CONTINUOUS BUTT WELD PIPE MILLS

Over the years, new ideas and engineering accomplishments have strengthened Aetna's position as the only builder in America of Continuous Butt Weld Pipe Mills. In recent months, Aetna Pipe Mill equipment has been installed in America, in Canada, in Germany, in England, in Japan and in Argentina.



CONTINUOUS COATING

This year Aetna will have completed the building of 25 continuous galvanizing lines, in addition to several terne and electrolytic tinning lines. Aetna has worked closely with industry in this development and is considered the pioneer in continuous coating equipment.



COLD DRAWING

The world over, Aetna-Standard is recognized as the leading authority and builder of cold draw equipment for tubes and bars. This year marked introduction of several innovations by Aetna, such as the air gripper carriage and hook.

THE AETNA-STANDARD ENGINEERING COMPANY • PITTSBURGH, PA.

Aetna-Standard

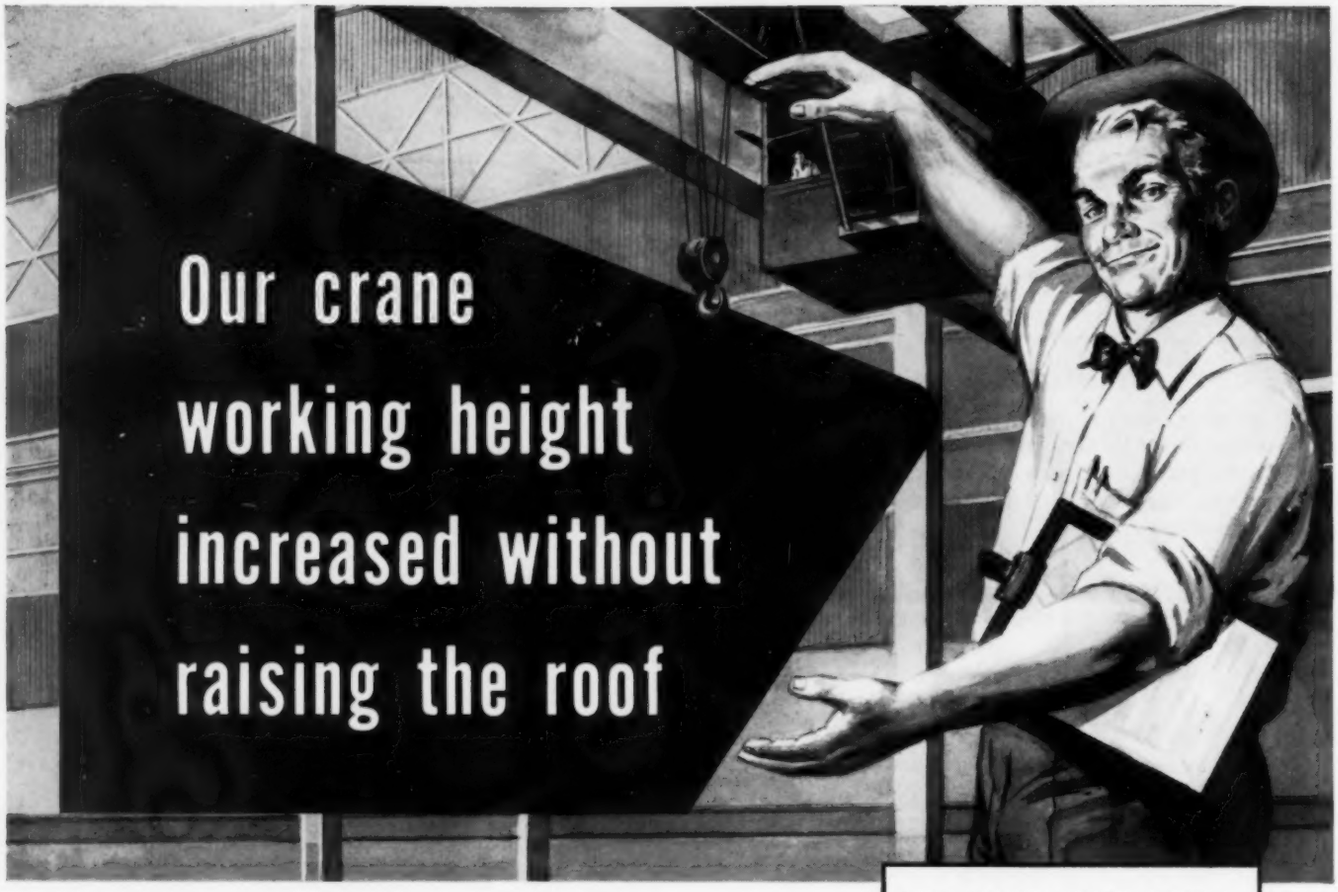
PLANTS IN WARREN, OHIO • ELLWOOD CITY, PENNSYLVANIA

GOOD EQUIPMENT BRINGS DOWN PRODUCTION COSTS

SUBSIDIARY and ASSOCIATED COMPANIES

Head Wrightson Machine Company, Ltd., Middlesbrough, England—Great Britain, Finland, Sweden, Norway, Denmark, Union of South Africa, Northern and Southern Rhodesia.
Aetna-Standard Engineering Company, Ltd., Toronto, Ontario, Canada.
M. Castellvi, Inc., New York, N. Y. — Mexico, Central and South America.
Societe de Constructions de Montbard, Paris, France — France, Belgium, Holland, Luxembourg, Switzerland.
Demag Aktiengesellschaft, Duisburg, Germany — Germany, Austria, Yugoslavia, Greece, Turkey, Egypt.
Compagnia Italiana Forme Acciaio, Milano, Italy — Italy.
Aetna-Japan Company, Ltd., Tokyo, Japan — Japan.
Hale & Kullgren, Inc., Akron, Ohio — Representative for the Rubber Industry.
Standard Engineering Company, Ellwood City, Pa.
Trans-World Traders, Pittsburgh, Pa.

Designers and Builders to the Ferrous, Non-Ferrous, Leather, Rubber, and Plastic Industries

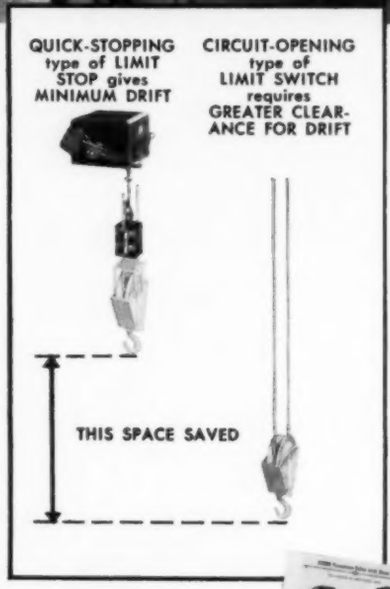


WITH EC&M YOUNGSTOWN SAFETY LIMIT STOPS

"We frequently needed more headroom on our D-c cranes. The limit stop setting couldn't be raised without sacrificing the clearance needed by the hoist-brake to safely stop the fast-moving empty hook, which hoists 2½ to 3 times faster than when hoisting full load. We had a choice . . . we could raise the roof . . . which meant deeper footings, heavier building columns and increased costs for lighting, heating and ventilating . . . OR . . . we could equip our cranes with **quick-stopping** EC&M Youngstown Safety Limit Stops."

Yes, Youngstown Hoist Limit Stops not only disconnect power from the motor but also apply **dynamic braking** to aid the hoist-brake in a **quick stop** . . . giving less drift . . . more headroom. **Safe,** too, because the tripping point does not change . . . is not affected by stretching of the hoist cables. The point at which the rising crane-hook makes contact to lift the Youngstown suspended-weight always remains the same.

For increased D-c crane headroom, **plus safety,** investigate EC&M Youngstown Safety Limit Stops.


QUICK-STOPPING type of LIMIT STOP gives MINIMUM DRIFT
CIRCUIT-OPENING type of LIMIT SWITCH requires GREATER CLEARANCE FOR DRIFT
THIS SPACE SAVED

Write today for Bulletin 1032 which describes and illustrates EC&M Youngstown Limit Stops.

1775

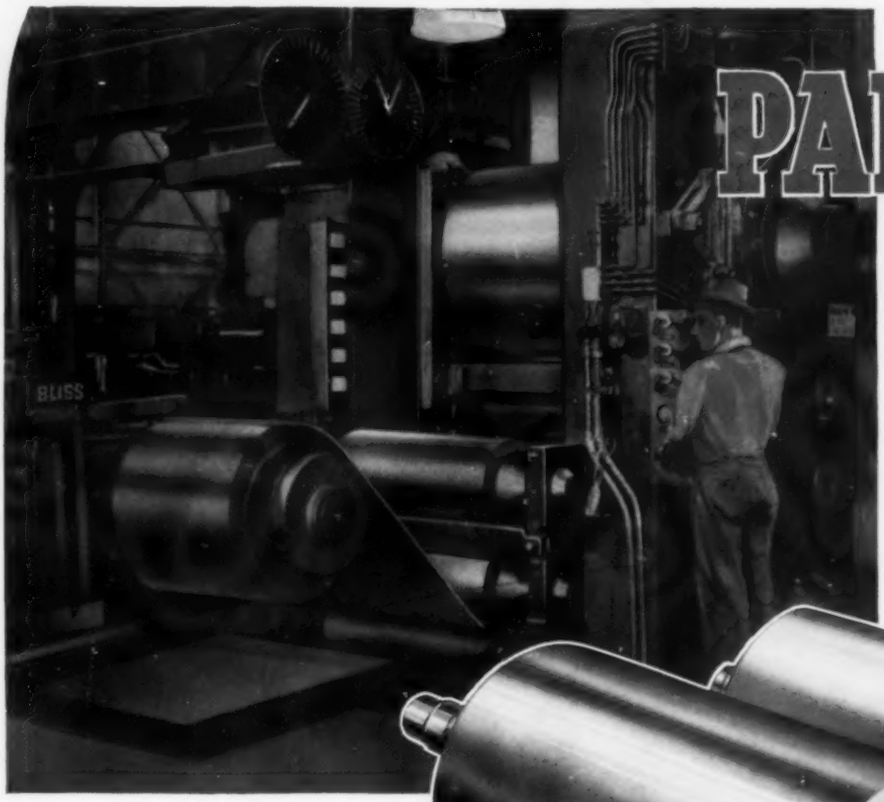
YOU CAN LIFT LOADS HIGHER AND SAFER WITH EC&M YOUNGSTOWN SAFETY LIMIT STOPS

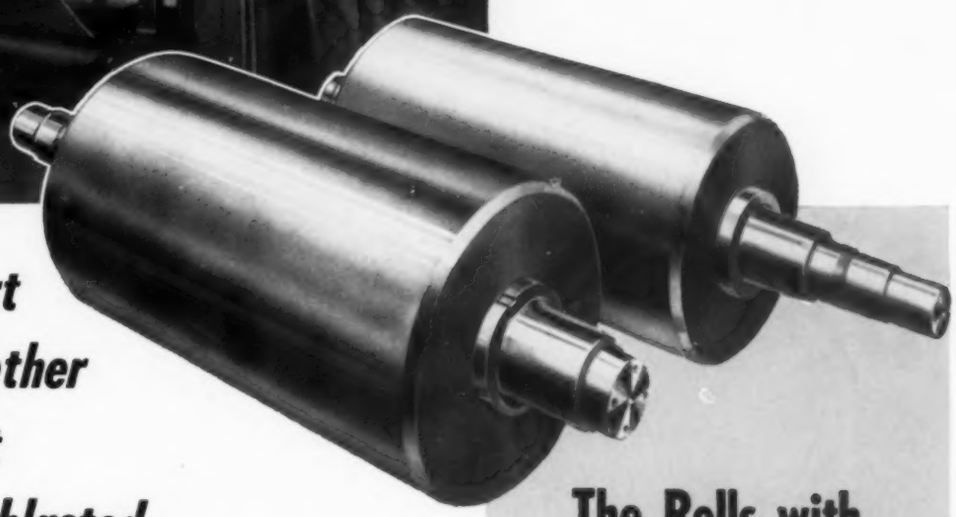
THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

Increase Production and Reduce Maintenance with F&Y m

PARALLOY

Temper Mill Tension Rolls





- ***Drive them apart***
- ***Drive them together***
- ***Run them bright***
- ***Run them sand blasted***

This Bliss Temper Mill rolls more tons with Paralloy—the rolls of uniform hardness that cut temper mill maintenance cost. Users report 4-6 months service between grinds. If you are not getting good tonnage over your present rolls, or from any other material handling application—call "YOUNGSTOWN"—Strip Mill Maintenance Specialists

The Rolls with Uniform Hardness

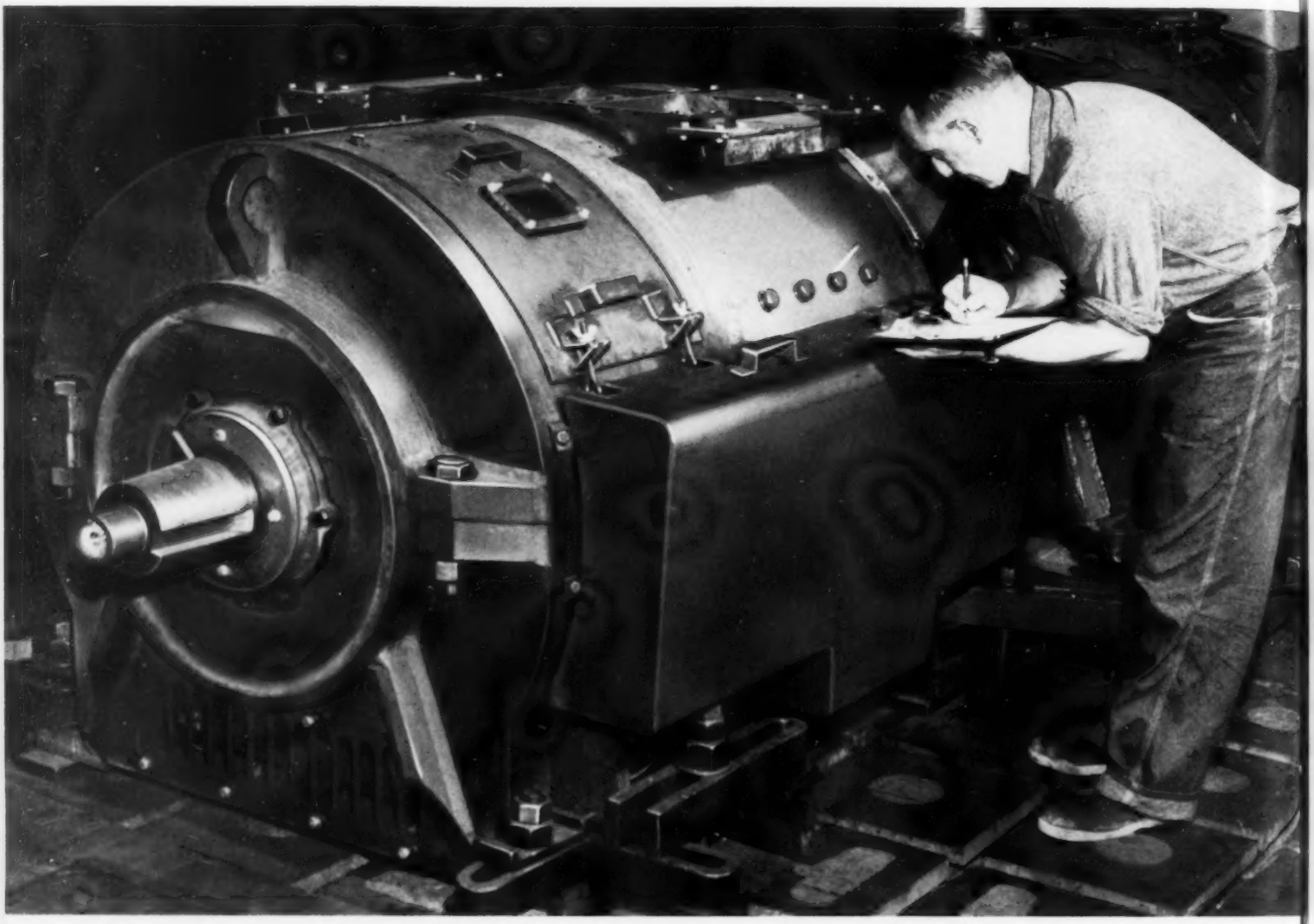
500-600 BRINNEL
from New to Scrap Diameter

Eliminate
SCRATCHING
GALLING
PICK UP
MARKING

The Youngstown Foundry & Machine Co.
OVER SIXTY YEARS OF SERVICE TO THE STEEL INDUSTRY
Youngstown, Ohio

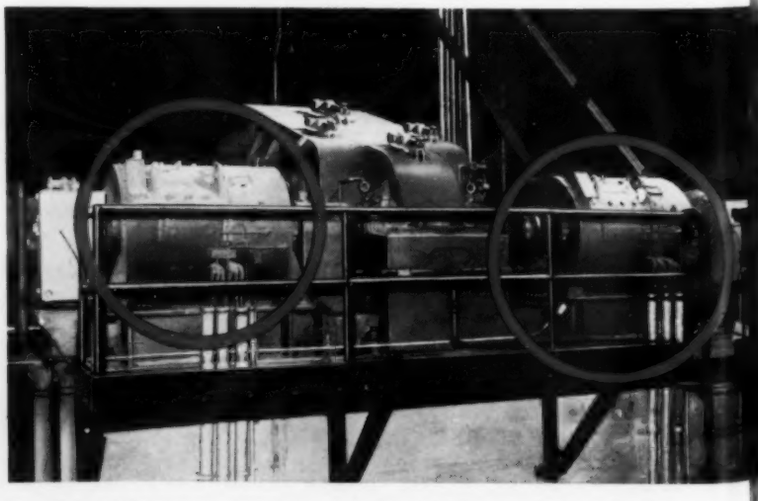
16

NEW G-E Armored Mill Motor—



TO ASSURE YOU of dependable service, this MD-622 is undergoing the rigid tests given to all G-E Armored Motors before shipment.

POWER SHOVEL equipped with compact G-E Type MD motors which have high overload capacity and the ability to take the terrific shocks of excavating duty.



SLAB SHEAR in reversing, blooming and slabbing mill is typical of severe applications in the steel industry that are dependably powered by G-E armored motors.

Most Powerful in its Class

Another G-E "first"—the MD-622—gives you more horsepower and torque than any other mill motor!

POWER-PLUS for the toughest heavy-duty application—that's the job of the MD-622—General Electric's latest addition to the MD-600 Armored Motor line.

AISE OBJECTIVES set up for smaller motors of this type, are met in the construction of the MD-622, which gives you more horsepower, increased commutating ability and better speed regulation in the same mounting dimensions as the earlier motor. Designed for duty in steel mills, power shovels, mine operations, dredges and ore bridges, it's ideal for extra torque, high momentary loads and snappy reversals.

RATED 500 HP AT 350 RPM when force ventilated, this motor delivers more torque relative to its size than any other mill motor ever built.

BETTER SPEED REGULATION can be maintained at higher speeds than in previous motors—and maximum safe speed is 20% higher.

WIDER SPEED RANGE is possible with the adjustable speed MD-622 and stabilizing series windings are not required, simplifying control on reversing operations.

REDUCED MAINTENANCE due to integral feet on armature. Out of frame, it stands by itself. Armature spider allows replacement of shaft without disturbing windings.

FOR NEW BULLETIN on MD-600 motors, fill out the coupon below. If you need more information, contact your nearest G-E Apparatus Sales Office. General Electric Co., Schenectady 5, N. Y.

Please send Bulletin GEA-4654C, "DC Armored Motors," which gives the complete story on the MD-600 line with examples of their reliable performance throughout industry.

General Electric Co.
Section C810-3
Schenectady, N. Y.

☐ Planning an immediate project.
☐ For reference only.

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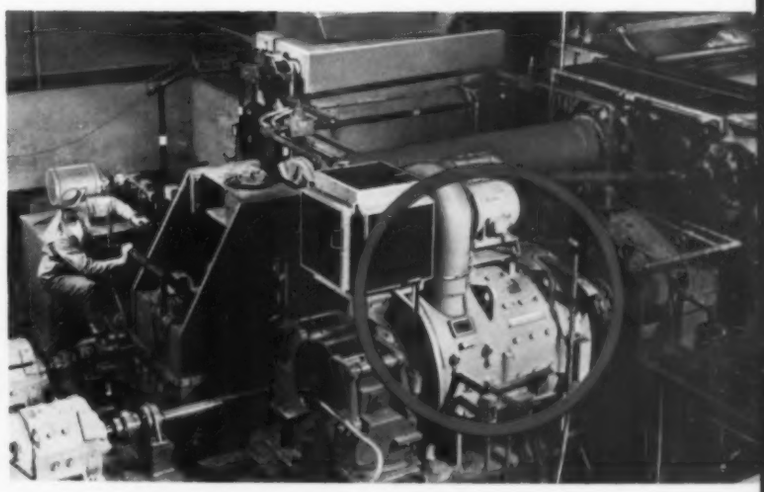
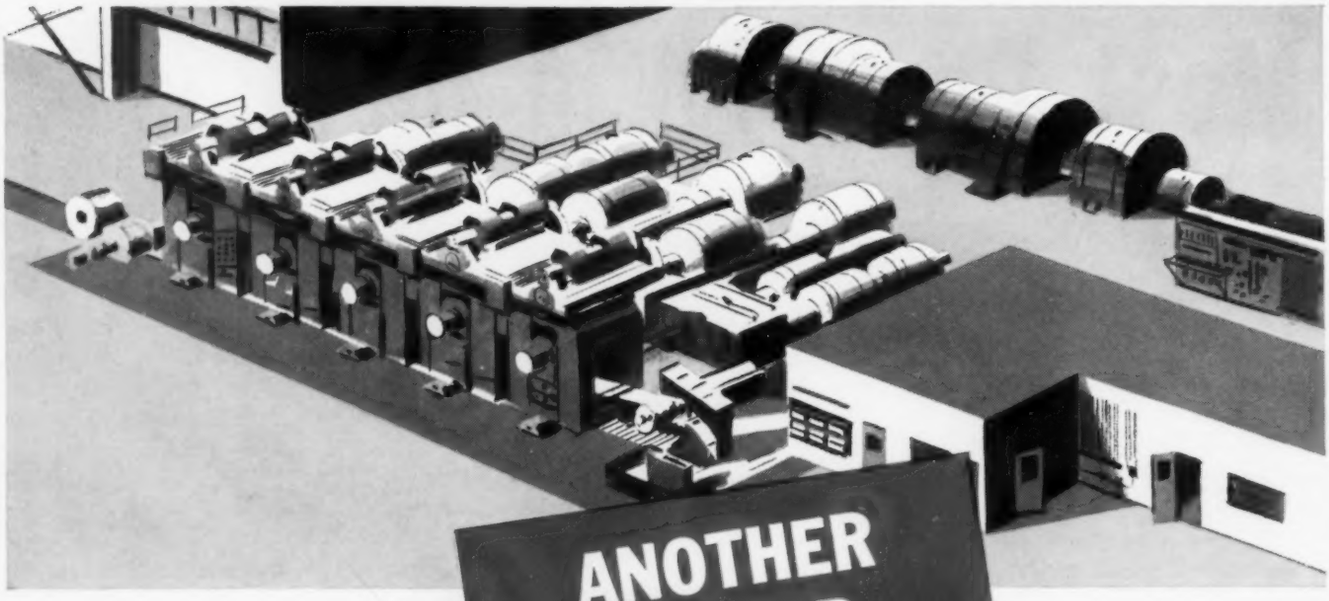
Progress Is Our Most Important Product

GENERAL ELECTRIC

DRAGLINE powered by amplidyne-controlled G-E armored motors—which were selected because of their high torque and quick reversing characteristics.



COILER in hot strip mill driven by force ventilated G-E armored motor with extra horsepower and mechanical strength to withstand severe operating conditions.



ANOTHER BIG JOB DONE BETTER

WITH NATIONAL BRUSHES
TRADE-MARK

NATIONAL CARBON has, for years, analyzed and supplied the proper brushes for large, steel-mill-production equipment.

TYPICAL EXAMPLE is a five-stand tandem cold mill of the type shown, covering just about the widest range of motor types and brush requirements found in any integrated unit. Calling upon its long experience and diversified product line, National Carbon recommended a specific brush grade for every electrical component in the mill, from pump motors to main drives.

RESULTS were outstandingly successful. Production was established at a high level of availability and has continued at the same rate.

NATIONAL CARBON COMPANY works closely with equipment manufacturers, power companies and principal users of industrial power. Customers know that for *all* motor and generator problems, no other brush supplier can match National Carbon's combination of experience, product-diversification and service-facilities.

Let "National" brushes show you how good really good brush performance can be!

ELECTRICAL AND MAINTENANCE SUPERINTENDENTS!
Give Your Men This FREE Maintenance Course

Mail coupon and receive as many copies as you need — without obligation. Short, entertaining, instructive installments. Profusely illustrated. Quick reference for many day-to-day maintenance problems. Useful for trainees. First mailing includes all back issues.

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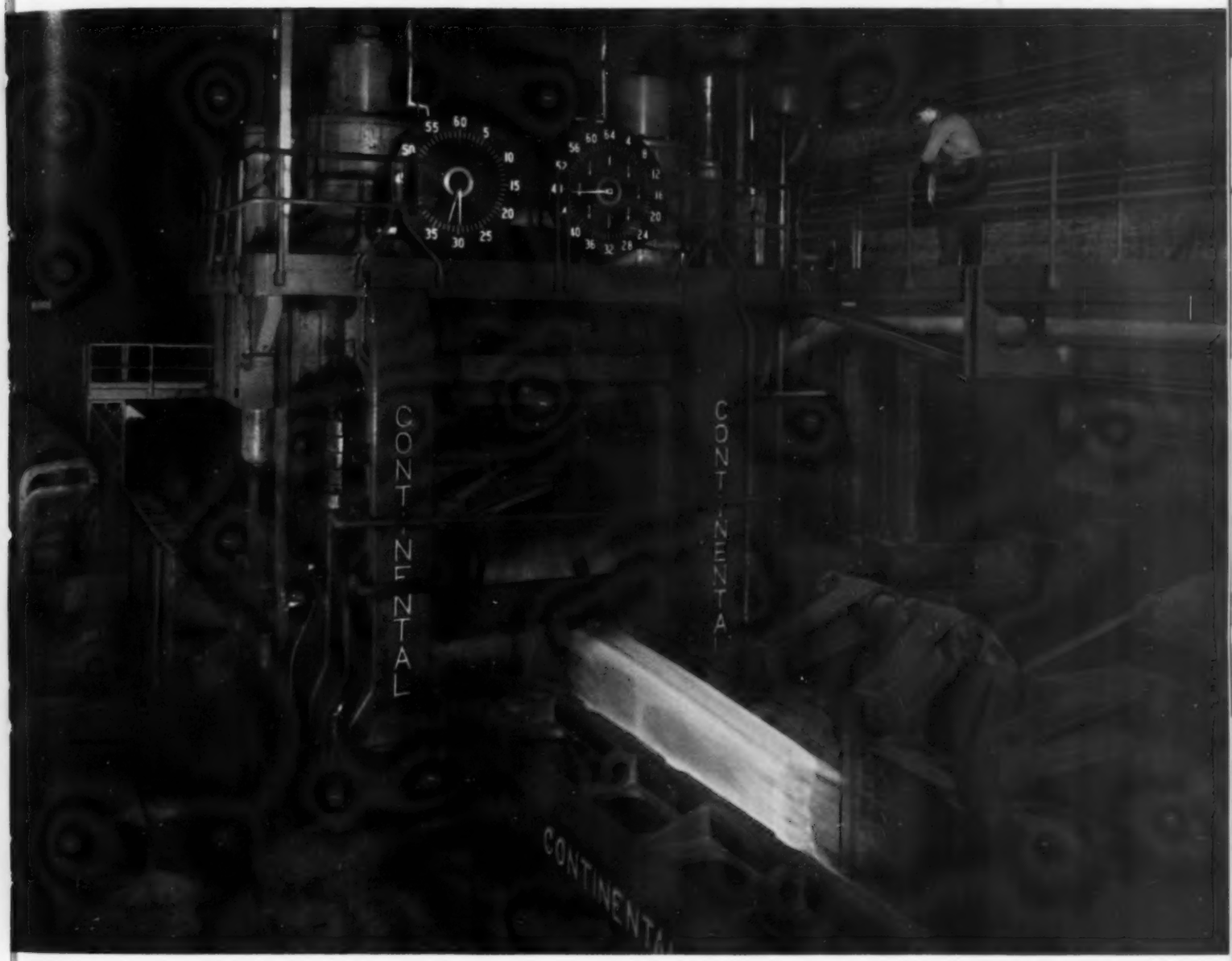
NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

IN CANADA: Union Carbide Canada Limited, Toronto

CONTINENTAL

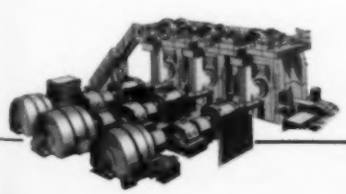
46-inch HIGH LIFT BLOOMING-SLABBING MILL



Producing Per Schedule

This mill has been producing per schedule ever since the installation was completed. Continental builds blooming-slabbing mills in a complete size range, offering twin-motor or pinion-stand drive, high-speed screw-downs and manipulators, plus other features designed for your specific needs. Continental also designs and manufactures universal, plate, hot strip, cold strip, temper, structural, rail, billet, rod and merchant mills. Continental service is complete from preliminary engineering to satisfactory operation, with all auxiliaries.

- COMPLETE ROLLING MILLS
- ROLLS • ROLL LATHES
- CONTINENTAL CHIPPER
- SPECIAL MACHINERY
- STEEL CASTINGS • WELDMENTS
- COPES-VULCAN BOILER CONTROLS AND CLEANING



Plants at
East Chicago, Ind. • Wheeling, W. Va. • Pittsburgh, Pa.
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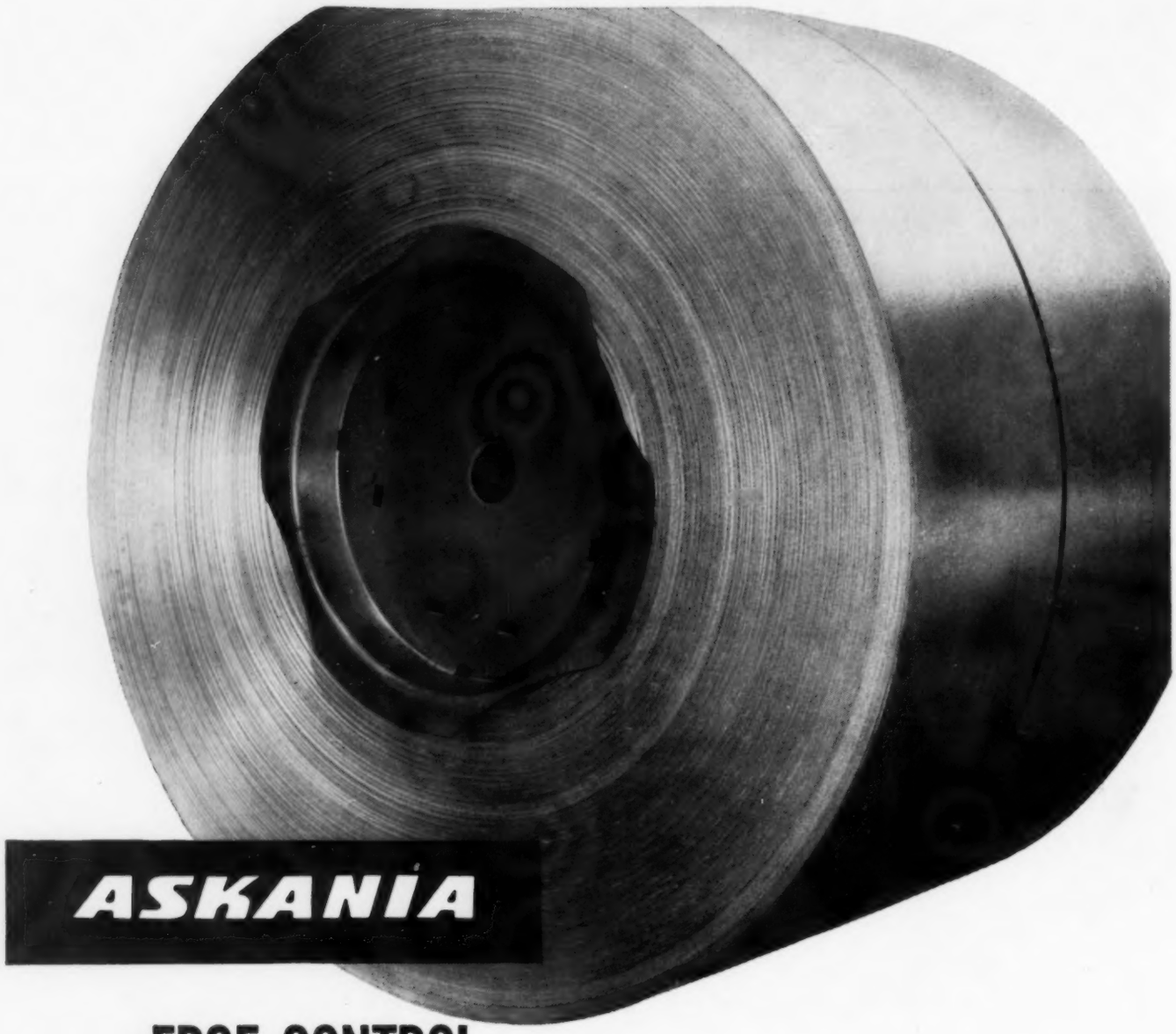


EDGE CONTROL

positions 65,000 lb. wind-up reel to deliver straight coils

This straight coil and others just like it are produced without exception on the continuous galvanizing line at the Wheeling Steel Plant in Martins Ferry, Ohio. Even though the coil and reel together weigh 65,000 lbs., the Askania Edge Position Control reacts with sufficient speed, precision and thrust to maintain the edge position within a tolerance of plus or minus .0156 of an inch.

Simple, dependable, powerful and accurate, the Askania control is the solution to the problem that previously defied control. Any mechanic can maintain it; it is self-lubricated; it incorporates only one moving part. It delivers power instantly in almost unlimited amounts for heavy loads. It is low in cost and built to take all the abuse that continuous operation in hard service can give.

In addition, Askania maintains a special abilities department, a reservoir of engineering experience, to cope with unique problems in servo or process control, or automation.

For full details, write for Bulletin 161 and 139.

ASKANIA REGULATOR COMPANY

246 E. Ontario Street, Chicago, Illinois

Subsidiary of General Precision Equipment Corp.

Announcing– the new LPD design **Clipper Oil Seal**

The design of the new LPD Clipper Seal assures that the spring which controls the lip contact on the shaft will be held tightly in the seal. It further provides a husky lip section that enables better control of lip flexing, and better utilization of the full available depth of the lip section.

. . . with reinforced heel developed especially for equipment used by the iron and steel industry

HERE IS THE newly designed Type LPD Clipper Oil Seal that lasts longer and seals more effectively than any previous design. It runs cool, sealing tightly even when shaft speeds are higher and equipment variables wide.

The new Type LPD Clipper Oil Seal can be supplied with the special reinforced heel developed to withstand the severe jolting of back-up roll bearing service. Thoroughly field tested, this special Clipper Seal is now being used with unusual success on hot and cold rolling mills, finishing trains, rod mills, wire mills and similar equipment.

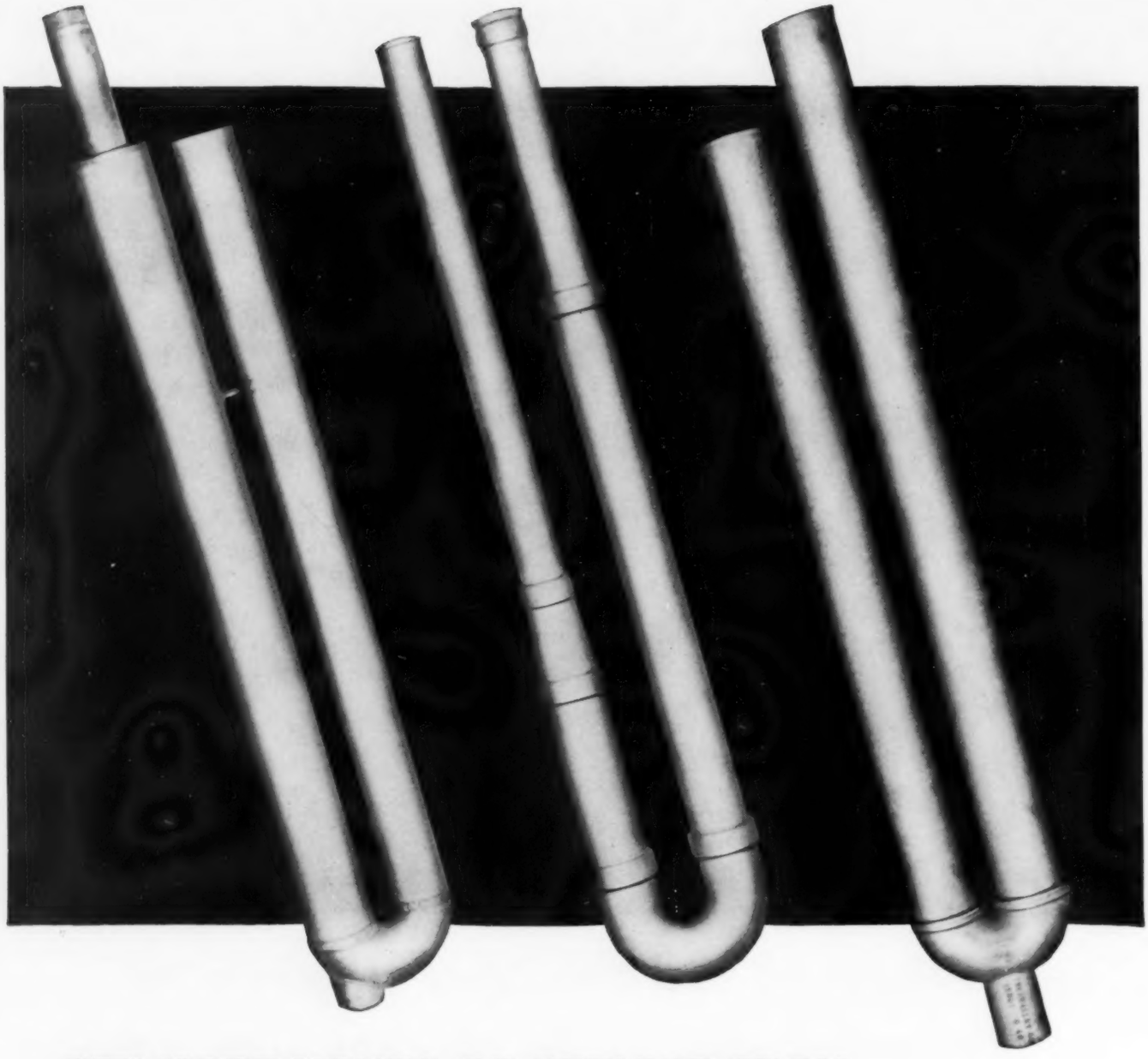
The longer life of this new Clipper Seal lessens replacements. It lasts longer and withstands higher shaft speeds because it requires less lubrication over its lip bearing area. Furthermore, the LPD design provides better utilization of the lip section of the seal—another factor in prolonging its life. And the greater flexibility of this lip section improves the performance of the seal.

• • •

For more information about the new Type LPD Clipper Seal with special reinforced heel, write Johns-Manville, Box 60, New York 16, N. Y.

JOHNS-MANVILLE PRODUCTS

Johns-Manville CLIPPER SEALS



GET MORE HOURS OF SERVICE FROM

Thermalloy* radiant tubes

Make Electro-Alloys your source if you want radiant tube assemblies that will give more life and reduce maintenance costs.

All components are produced in suitable analyses under close metallurgical supervision, and with X-ray control. The straight tube sections are centrifugally cast in such a way that wall thickness is uniform throughout; i. e., inside diameter and outside diameter are concentric, and thickness is the same the full length of the tube. All finished assemblies are pressure-tested before shipment to insure freedom from leakage. As a result, you are assured of radiant tube assemblies that last longer without cracking, warping or sagging.

Whatever your needs in radiant tube assemblies or other heat-treating equipment—you'll get more operating economy from high heat-resistant Thermalloy castings. Let us know your requirements. Call your nearest Electro-Alloys engineer or write Electro-Alloys Division, 5006 Taylor Street, Elyria, Ohio.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION

ELYRIA, OHIO

*Reg. U. S. Pat. Off

another new—service-proved—
HARBISON-WALKER PRODUCT
semi-silica fireclay refractory of super-quality

For Soaking Pits	For Blast Furnace Stoves	For Open Hearth Regenerators	For Hot Metal Mixers	For Heating Furnaces

service

KAOSIL, having an added margin of the particular, beneficial properties of semi-silica fireclay brick is a truly unique refractory. The enhanced physical and chemical properties of KAOSIL extend the range of usefulness of the highly siliceous type of fireclay refractories.

composition

KAOSIL is made from exceedingly fine grained siliceous kaolin of exceptional purity and uniformity. Its silica content is approximately 75 percent and its content of basic oxides of alkalies and alkaline earths is phenomenally low—less than 1 percent.

superior characteristics

KAOSIL has exceptional stability under load in soaking heats of long duration.

Purity in composition of KAOSIL accounts for its high refractoriness and high temperature of vitrification.

The resistance of KAOSIL to structural spalling and fluxing by alkali laden gases are other properties of prime importance.

Excellent workmanship is assured by the power press method of forming.

HARBISON-WALKER REFRACTORIES CO.
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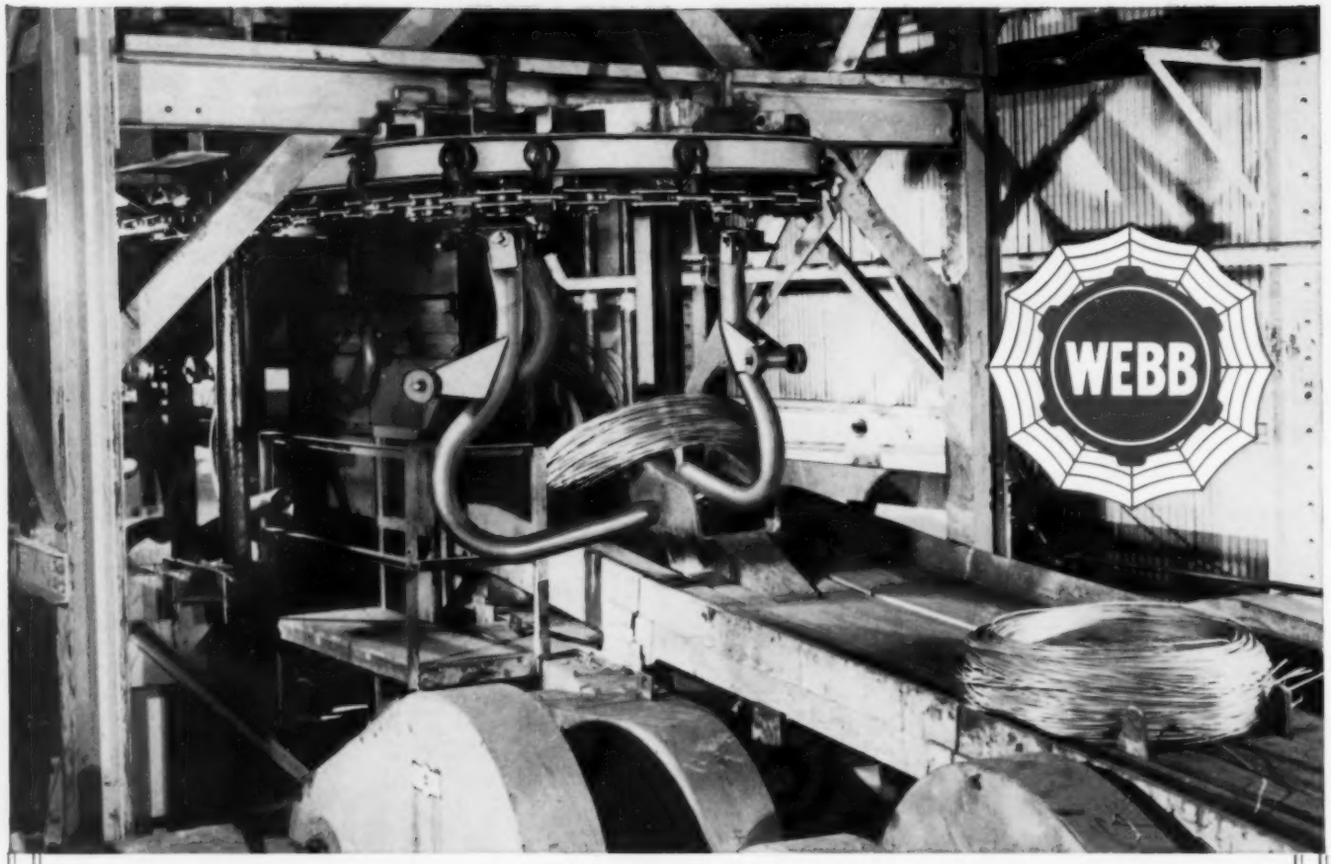
World's Largest Producer of Refractories
GENERAL OFFICES: PITTSBURGH 22, PENNSYLVANIA



Jones & Laughlin Hot Rod-Coils Handled *Automatically* By Webb Conveyors

Hot from the laying or pouring reels, these coils of rod steel are handled automatically by Webb Conveyors throughout their trip to storage or shipping in the Jones & Laughlin Rod Mill at Aliquippa, Pa.

Rod coils are approximately 46" in diameter and weigh 600 pounds—4 of these hot coils are handled by Webb Conveyors every minute without a hand touching them. Single and double-strand drag conveyors and overhead trolley conveyors are employed in this highly integrated materials handling system.

Typical of the smooth automation and ingenious transfer of coils from one conveyor to another is the illustrated lifting of coils by a cam actuated bobber at the end of the drag conveyor, and automatic insertion of trolley conveyor hook into rod coils. This operation is accomplished without distortion of coils, and in spite of loose rod ends.

Ask a Webb engineer to look at your tough handling problems—his experience and engineering knowledge are waiting your call.

Additional Webb Services—Through its subsidiaries, Control Engineering and Webb Forging Co., the Jervis B. Webb Co. designs and manufactures electronic and electrical controls for conveyors, machine tools, etc. Also quality drop forgings.

JERVIS B. WEBB CO.

Conveyor Engineers and Manufacturers

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Send for fully illustrated catalog that provides complete information on Webb conveyors

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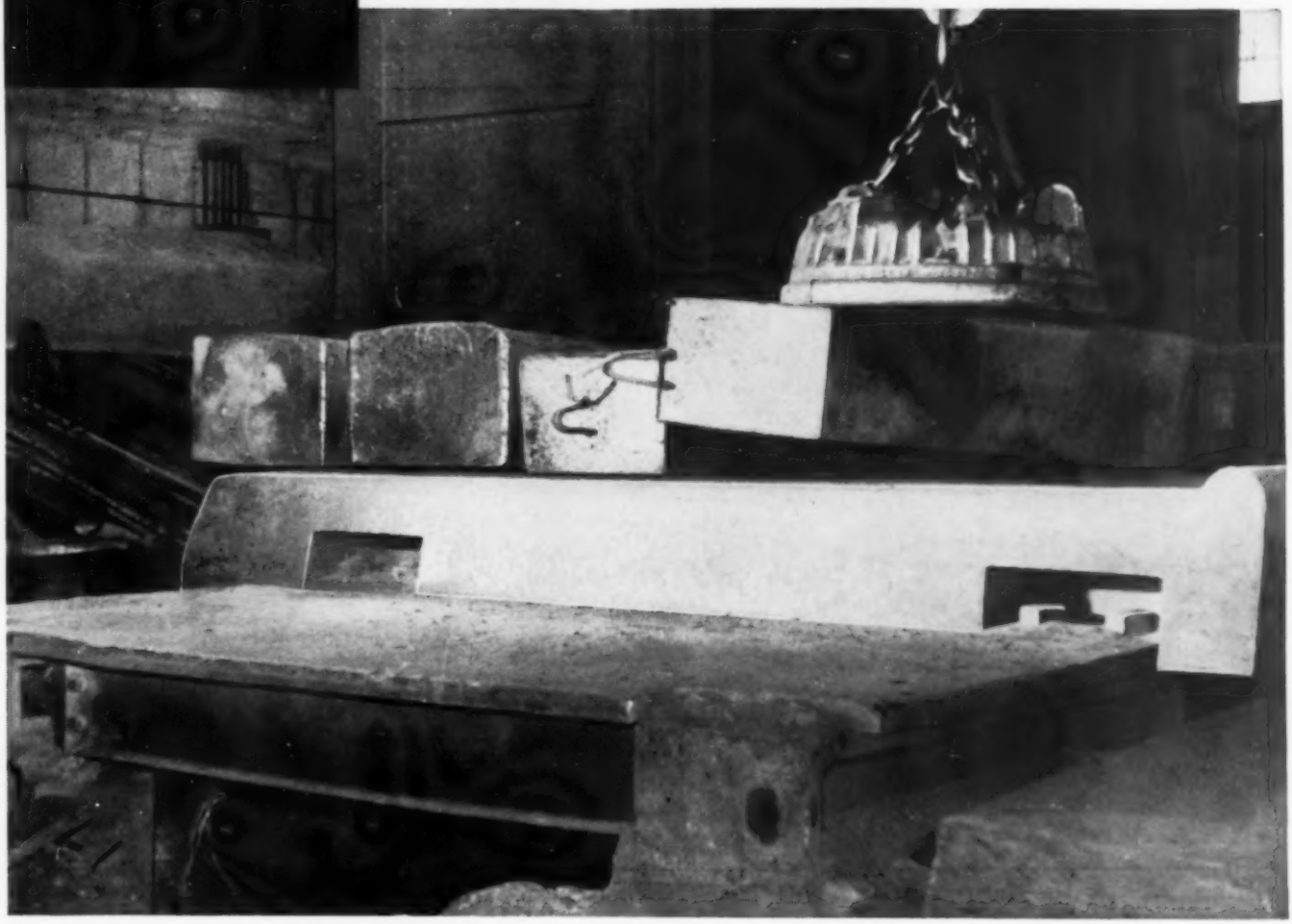
OFFICES AND REPRESENTATIVES THROUGHOUT THE WORLD

It takes Rugged SKID Design by BIRDSBORO



to withstand constant impact of heavy ingots!

Designers and Builders of:

STEEL MILL MACHINERY
HYDRAULIC PRESSES
CRUSHING MACHINERY
SPECIAL MACHINERY
STEEL CASTINGS
Weldments "CAST-WELD" Design
ROLLS: Steel, Alloy Iron, Alloy Steel

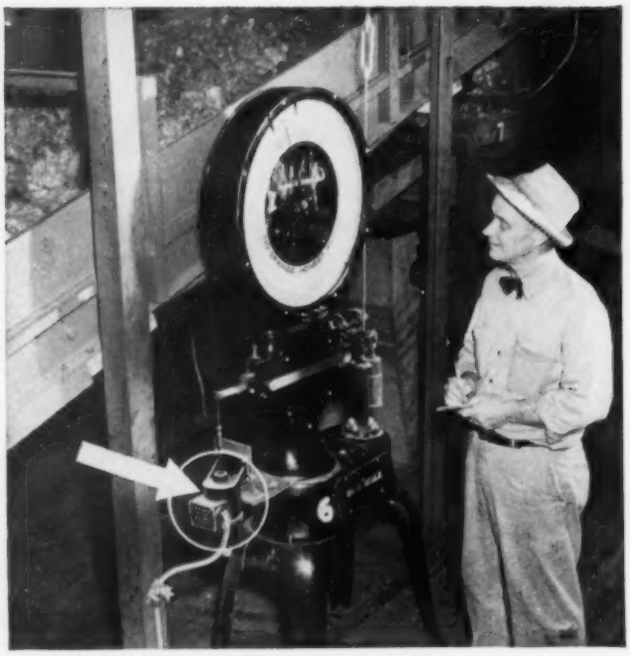
A magnet piles heavy ingots onto these rugged BIRDSBORO-built skids for transferring to the inclined chain drag conveyor at left. It's a tough job demanding the heaviest and most rugged design of mechanical equipment.

Wherever tough service conditions exist, you'll find the name BIRDSBORO on all types of dependable, trouble-free mill machinery.

MM-36-54

BIRDSBORO

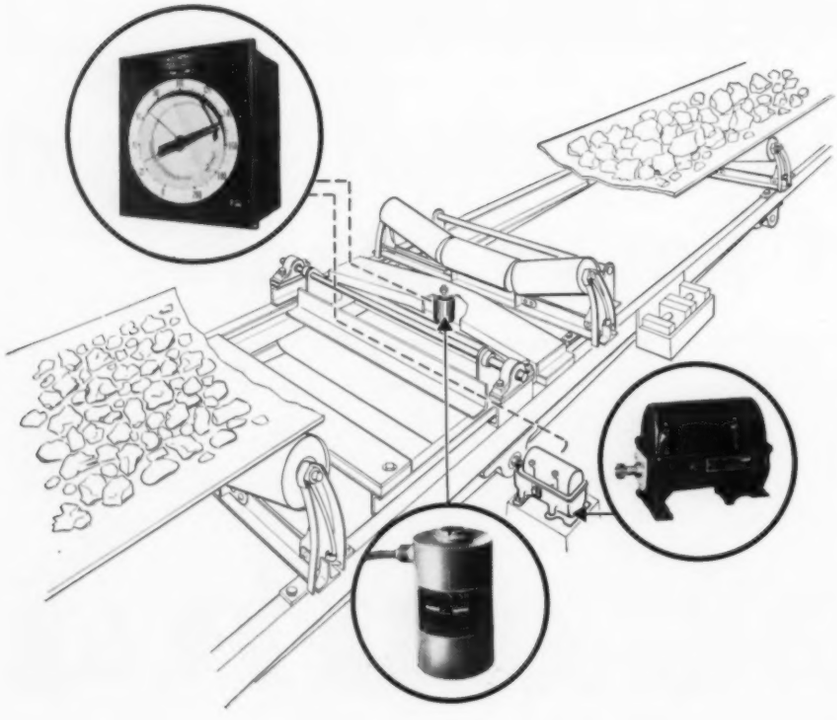
BIRDSBORO STEEL FOUNDRY & MACHINE CO., BIRDSBORO, PENNA. Offices in Birdsboro, Pa. and Pittsburgh, Pa.



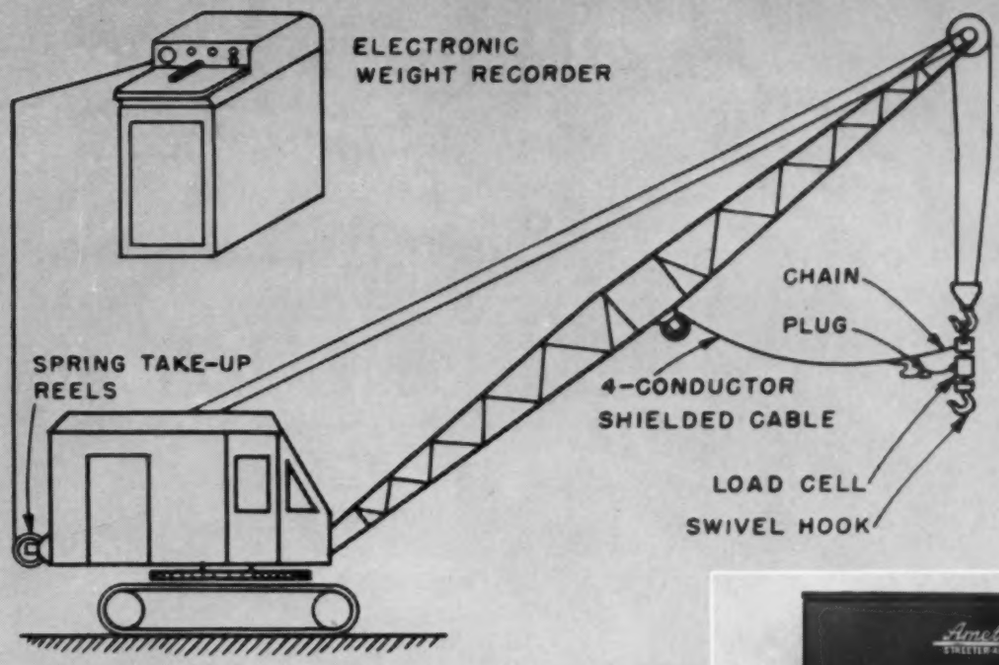
Brown Motion Transmitter is readily adapted to weight measurements by mechanical linkage to a scale beam. The sensing element transmits to an Inductance Bridge Receiver, which indicates, records and controls. Applicable to conveyors, tanks, bins already equipped with mechanical scales. See Data Sheet No. 11.5-2.

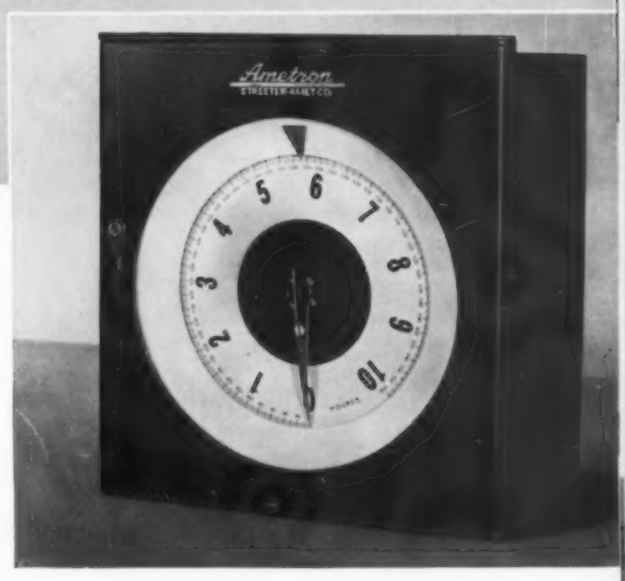
Gilmore Electronic Scale, shown applied to weighing of scrap charge in an open hearth furnace operation, uses Baldwin SR-4 load cells with Brown Servo Amplifier system. This equipment is also applicable to numerous other light and heavy-duty weighing problems. See Data Sheet No. 10.18-4.

Automatic electric weighing systems bring new control ideas



***Trans-Weigh Co. Belt-Meter** weighs materials in transit on belt conveyors and monorails. **ElectroniK** recorder charts the instantaneous rate of flow of material on the belt, and a special integrating circuit adds up total weight delivered. See Data Sheet No. 10.18-3.*





Ametron Electronic Scale, made by Streeter-Amet Co., utilizes Baldwin load cell with ***ElectroniK*** *amplifier and Brown servo motor to record weight on crane hooks, track scale, overhead cranes (illustrated in diagram).* ***ElectroniK*** *circular scale indicator gives continuous indication of weight. See Data Sheet No. 10.18-2.*

to steel production

MODERN methods of continuous electrical weighing of solids are opening up new avenues of control... new sources of production economy . . . in the steel industry. Utilizing Baldwin-Lima-Hamilton SR-4 load cells, *ElectroniK* recorders and Brown servo components in systems designed by various manufacturers, this technique affords a number of distinct advantages.

Remote measurements are readily made. The electrical strain gage type load cell can be located hundreds of feet from the indicating or recording instrument. This flexibility permits spotting the instrument in a foreman's office, on a central panel, or wherever needed for supervisory purposes.

Versatility. Electrical weighing is applicable to materials on belts or conveyors, on cranes, in hoppers, in railroad cars, in ladles. It is readily installed on existing equipment, usually with only minor modifications required.

Automatic control. Continuous measurements can often be used to initiate automatic control systems for regulating proportions of ingredients, for operating alarms or for other tasks now requiring human attention.

Ruggedness. The inherently sturdy strain gage type load cell units can take 120% overloads without adverse effects . . . are hermetically sealed with no moving parts.

Several typical electrical weighing systems are illustrated here, together with the Brown Motion Transmitter which is also applicable to weight recording. Your nearby Honeywell sales engineer will be glad to discuss your own application . . . or, if you prefer, a representative of the manufacturer of the specific system will consult with you.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Data Sheets on specific weighing systems, and for Data Sheet No. 10.18-1a, "Baldwin SR-4 Devices."

H HONEYWELL

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

The Amerigear® patented fully crowned tooth form...

...IS THE SOURCE OF

High Misalignment Capacity*

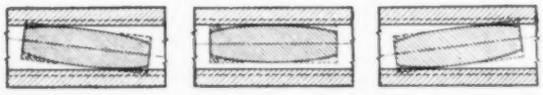
IN Amerigear® COUPLINGS

Illustrating Full Cycle Misalignment Pattern of Amerigear H.M.C.*Patented Tooth Form.

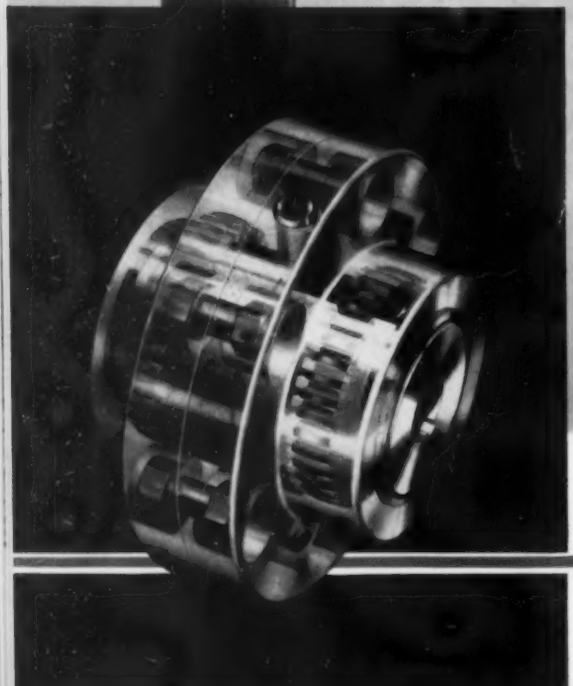
- An engineered application, using advantages of the Patented Amerigear HMC* Flexible Coupling, can solve any power transmission problem arising from:

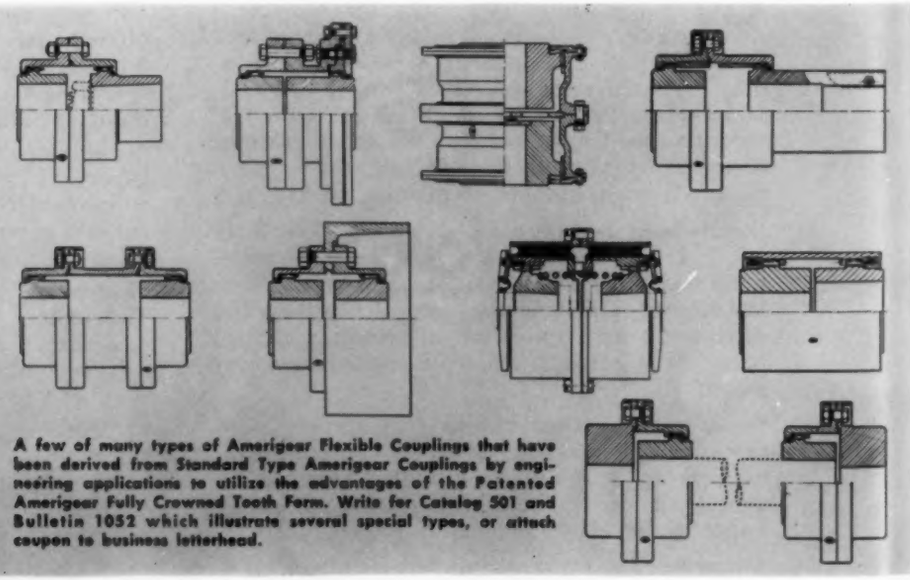
- **Excessive lateral and angular misalignments;**
- **Tight backlash requirements;**
- **Space limitations;**
- **High speeds and loads;**
- **Continuous operation;**

or any combination of these



Comparison with gearing of conventional gear-type couplings shows how Patented Amerigear Tooth Form eliminates *tooth end loading* and simultaneously allows for both lateral and angular misalignment. Dotted lines indicate gear teeth of conventional gear couplings.





A few of many types of Amerigear Flexible Couplings that have been derived from Standard Type Amerigear Couplings by engineering applications to utilize the advantages of the Patented Amerigear Fully Crowned Tooth Form. Write for Catalog 501 and Bulletin 1052 which illustrate several special types, or attach coupon to business letterhead.

Amerigear®

HMC* FLEXIBLE COUPLING

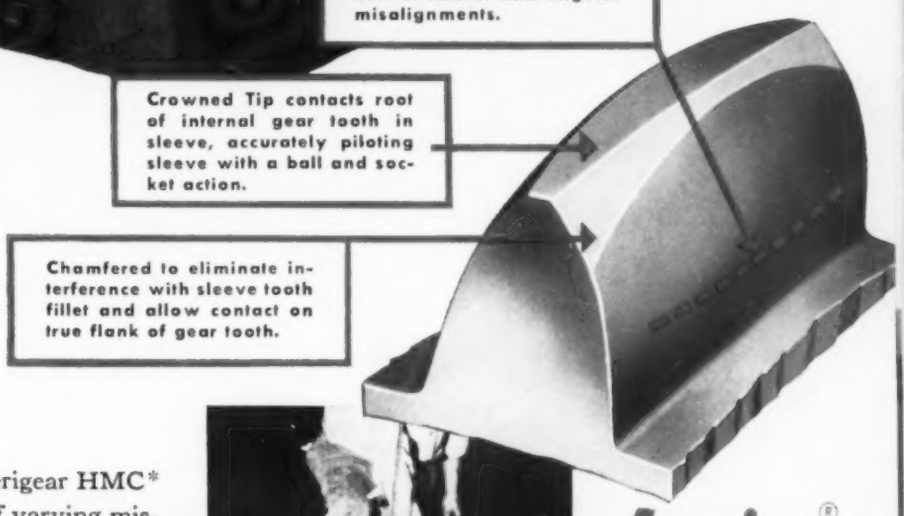
One of several standard types embodying the Patented Amerigear Tooth Form

Patented and Patents Pending

Amerigear® REDUCES STRESS ON 5770 H.P. TURBINE BLOWER DRIVE . . . .

Close-up of special continuous lubricated tandem-unit Amerigear Coupling, used on blast furnace turbine blower at Jones and Laughlin Steel Corporation, Aliquippa Works. Unit is dynamically balanced, operating at 3800 to 4200 r. p. m. under high centrifugal and torque conditions.

ENGINEERED TANDEM-UNIT SPACER COUPLING TRANSMITS SMOOTH, FULL FLOW OF POWER, CONTINUOUSLY 24 HOURS PER DAY


Crowned Flank carries all the load and provides correction of lateral and angular misalignments.
Crowned Tip contacts root of internal gear tooth in sleeve, accurately piloting sleeve with a ball and socket action.
Chamfered to eliminate interference with sleeve tooth fillet and allow contact on true flank of gear tooth.

Another example of the effectiveness of Amerigear HMC* Flexible Couplings in solving problems of varying misalignment—in this case, as used on a blast furnace turbine blower. Specially engineered for this installation, two Amerigear Couplings are assembled with a spacer between to form a "tandem" unit capable of compensating for the highest degree of starting or operating misalignments. The Patented Fully Crowned Tooth Form design of the gear teeth in Amerigear Couplings eliminates loading of tooth ends and tips. All thrust and load is carried evenly on the strong flanks of the gear teeth—preventing excessive wear or breakage and costly downtime; avoiding those troublesome breakdowns that lead to production losses.

Adaptable to the widest variety of power transmission requirements, Amerigear HMC* Couplings are being used with outstanding success on driving rolling mills, where high misalignment capacity is necessary to compensate for roll wear, heavy presses, slitters, reels, cranes and other steel mill equipment.

Amerigear®

Patented Fully Crowned Tooth Form

. . . eliminates tooth end and tip loading.

. . . permits greater angular and lateral misalignment without wear or loss of power.

Amerigear Engineers are ready to assist you in planning for the use of standard Amerigear Couplings or engineering special applications. Write for Catalog 501 and Bulletin 1052, or attach the coupon below to your business letterhead. *HMC means High Misalignment Capacity; engineered into every Amerigear Coupling.

AMERICAN FLEXIBLE COUPLING COMPANY
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Please send me further information regarding AMERIGEAR COUPLINGS with the Patented Fully Crowned Tooth Form as described in Catalog No. 501 and Bulletin 1052.

Name ..... Title .....

Company .....

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City ..... Zone ..... State .....

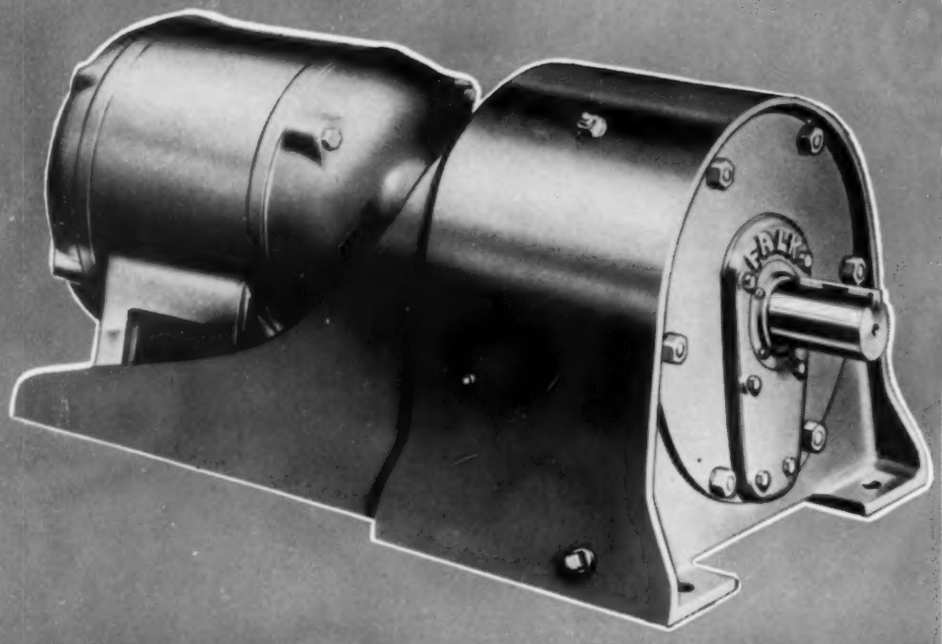
Please attach to your business letterhead.

Dept. 928ISE

Choose the All-Motor type,

ALL-STEEL FALK Motoreducer

...with complete foot-mounted motor of ANY make ANY type ANY speed



Its exclusive, superior features mean LONG-RANGE ECONOMY!

You get more for your money in a FALK all-steel, All-Motor type Motoreducer. Here is the *only* compact motorized reducer with a separate foot-mounted, resilient Steelflex coupling-connected, standard motor without modifications! It accommodates *any* make, type, or speed of motor within the AGMA rating of the unit. Ratio can be changed within torque capacity of unit without modifying motor.

The simplified construction of the FALK All-Motor type Motoreducer means real long-range economy. Motors or reducer units can be quickly and easily interchanged from one line or plant location to another. Fully standard replacement motors from manufacturers' field stocks are always available without costly delivery delays or special motor or shaft modifications.

When you choose a FALK All-Motor type Motoreducer, you get the utmost in design, versatility of performance, and utility—plus the greatest possible dollar-for-dollar value throughout its traditionally long life... Available in any standard ratio from factory and distributor stocks throughout the country. Write for Bulletin 3104.

Every FALK Motoreducer has these "IN-BUILT" FACTORS

1 **All-steel Housings.** Unbreakable, strong, rigid. Generous overhung load capacities provided by wide bearing spans, large shafts and bearings.

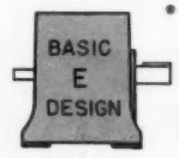
2 **Streamlined inside and outside.** Smooth, clean surfaces; machine welded construction conforms to NEMA motor frames.

3 **Sealed Housings.** Dual closures and one-way vents keep oil *in*, dust and moisture *out*. Units are splashproof, leakproof, dustproof.

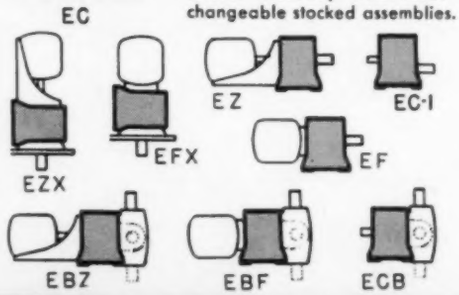
4 **Positive Lubrication.** Large sump capacity ...oil-tight construction assures clean lubricant...direct dip of revolving elements provides positive lubrication at all speeds.

5 **Wide Speed Range.** Selective ratio combinations provide output speeds from 1.5 rpm to 1430 rpm with stock gears.

6 **Precision Gearing.** Heat-treated alloy steel, precision cut and shaved helical gearing throughout...quiet-operating crown shaved pinions...taper bored gears for easy ratio changes.



The basic E design permits maximum use of standardized parts . . . closer control over materials, processing, inspection and assembly . . . resulting in faster delivery from interchangeable stocked assemblies.



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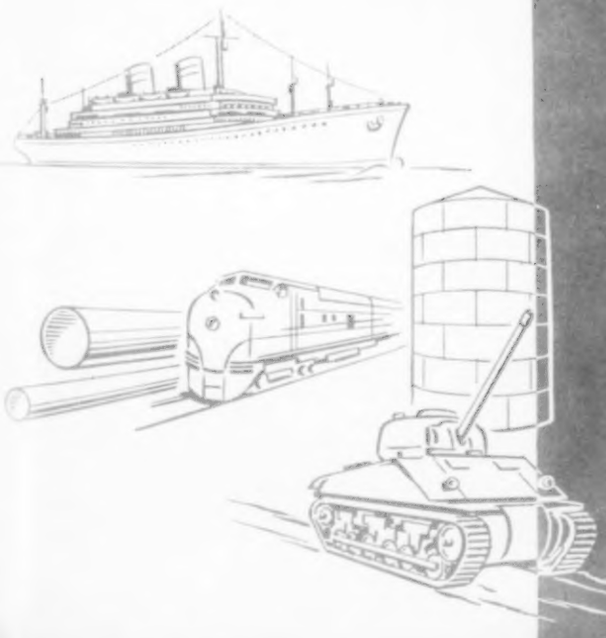

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STEEL GRID RESISTORS
consistently prove their value in
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Records shattered! TIMKEN® bearings hit 8 million ton mark on this plate mill

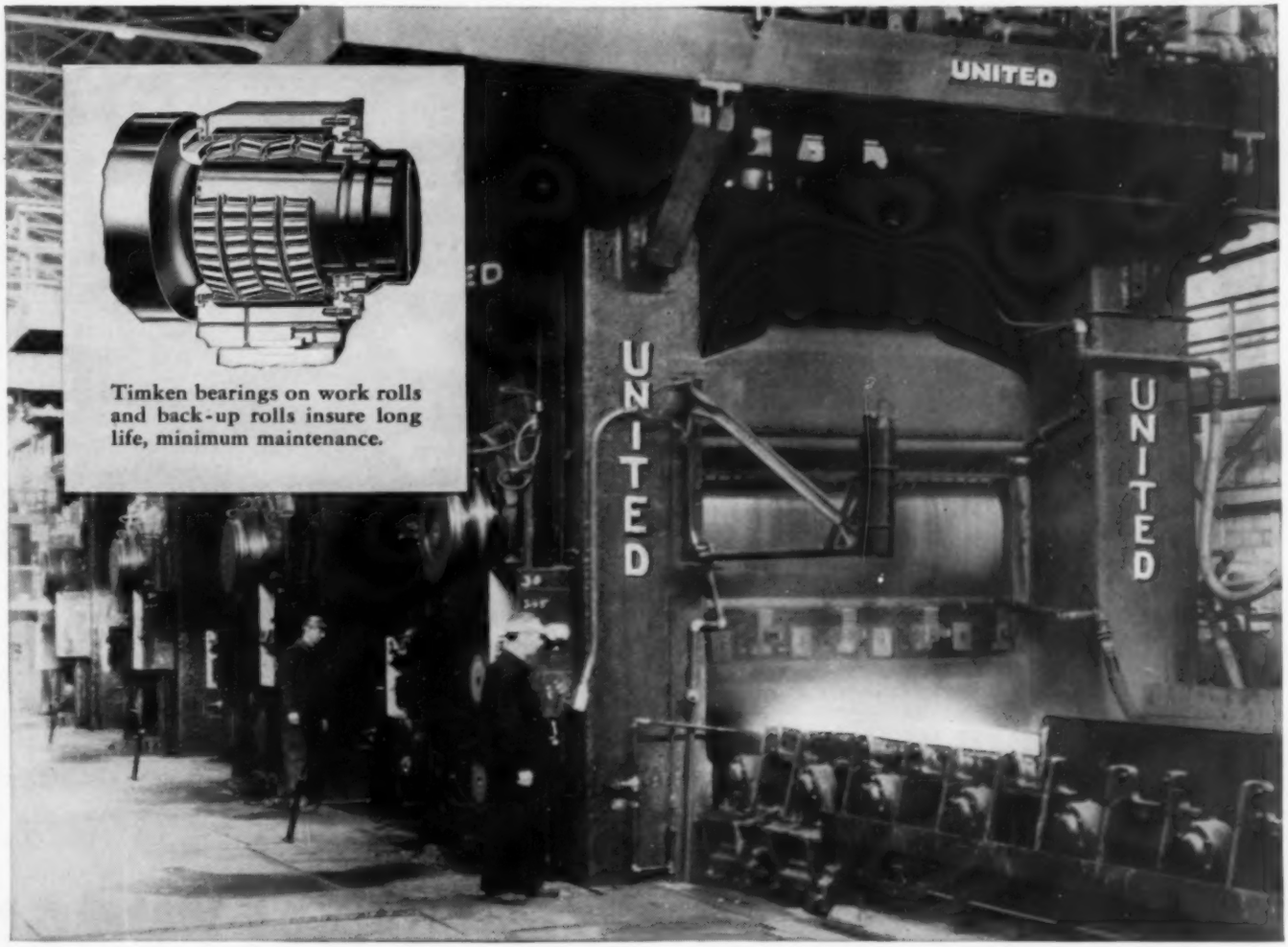
THE 31 Timken® tapered roller bearings on this United semi-continuous plate mill at U. S. Steel's Homestead Works have now rolled an average of 5 million tons. And some of the Timken bearings have rolled over *eight million tons!*

One reason for this remarkable record is the high load capacity of Timken bearings. They carry the load on full lines of contact between races and rollers. A second reason is the extremely low frictional resistance of Timken bearings. They are geometrically designed to have true rolling motion and are manufactured to live up to this design.

The design of rolling mills is simplified with Timken bearings because no extra thrust devices are required. Timken bearings take both radial and thrust loads. Thus chuck mountings are simpler and more compact. Timken bearings greatly simplify lubrication because they use grease—no tubes, pipes or reservoirs are needed.

Timken bearings make all kinds of machinery run better and last longer. When you buy or build machinery always look for the trademark "Timken" on the bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



Timken bearings on work rolls and back-up rolls insure long life, minimum maintenance.

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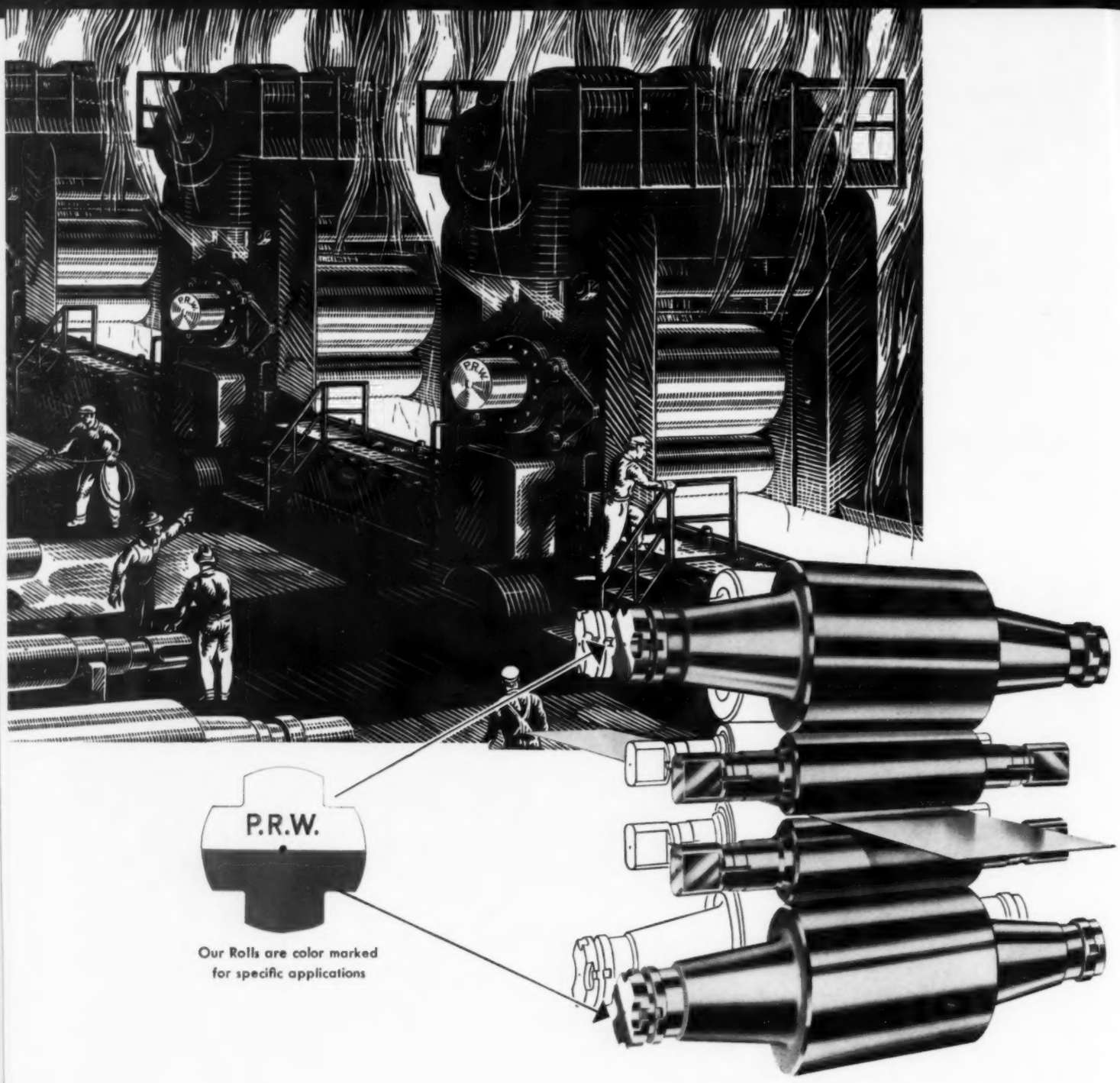
MAGNIFYING GLASS INSPECTION OF EVERY ROLLER!

Every one of the over one billion Timken bearing rollers produced every year is inspected with powerful magnifying glasses to detect surface flaws. It's just one example of how the Timken Company insures uniform high quality.



Our Rolls are color marked for specific applications

The right roll in the right stand

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Engineering, design and application service are readily available to you through our roll engineers . . . who combine practical experience with technical know-how . . . in the selection of the *right* roll for *each* application in your mill.

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Patent Reviews

By MELVIN NORD
Patent Attorney
Detroit, Mich.

. . . . copies of patents may be obtained from the Commissioner of Patents, Washington, D. C., at 25 cents each . . . patents reviewed cover period July 13, 1954 to August 3, 1954 . . . .

SMOKE AND FUME TAKEOFF FOR AN ELECTRIC FURNACE

▲ While electric furnaces are not ordinarily bothersome, insofar as the generation of smoke is concerned, there are times when such furnaces, particularly when used in melting down scrap, may produce substantial quantities of smoke and fumes. Increasing public consciousness against contamination of the atmosphere, and the increasing prevalence of anti-smoke ordinances, has led to various attempts to take care of the smoke, but in the case of tilting type electric melting furnaces, the arrangements provided have not been satisfactory. When a furnace is used for the melting down of scrap, which might be coated with grease or paint, large quantities of smoke are generated, and flames and smoke are expelled upwardly around the electrodes, and from around the edge of the roof, and there may be a substantial increase in pressure inside the furnace. The presence of a smoke hood with suction tends to increase the velocity of the incandescent gases pouring out in volume from around the roof and around the electrodes. This tends to greatly increase the consumption of the graphite or carbon electrodes, and has a destructive action on all equipment adjacent the roof of the furnace.

In U. S. 2,684,392, issued July 20, 1954 to William E. Moore and assigned to Delaware Engineering Corp., an offtake pipe is provided on the furnace, preferably below the floor, and it projects from the side of the furnace. When the furnace is in the normal operating position, the outer end of this discharge pipe registers with a down pipe leading to a suction fan. When the furnace is tilted, either for pouring off metal or slag, the outlet pipe on the furnace simply swings out of register with the suction pipe. During the operations of pouring and slagging, smoke and gases in substantial quantities are not produced, and when the furnace is moved back to its horizontal position, the offtake mates with the down pipe.

The apparatus is shown in Figure 1. A short gas offtake pipe 10 is constructed on the side of the furnace below the roof, and it opens into the interior of the furnace. It may be of a water-jacketed construction with a water inlet 11 to the jacket, and a water outlet 12. Flexible hoses may be connected to the water inlets and

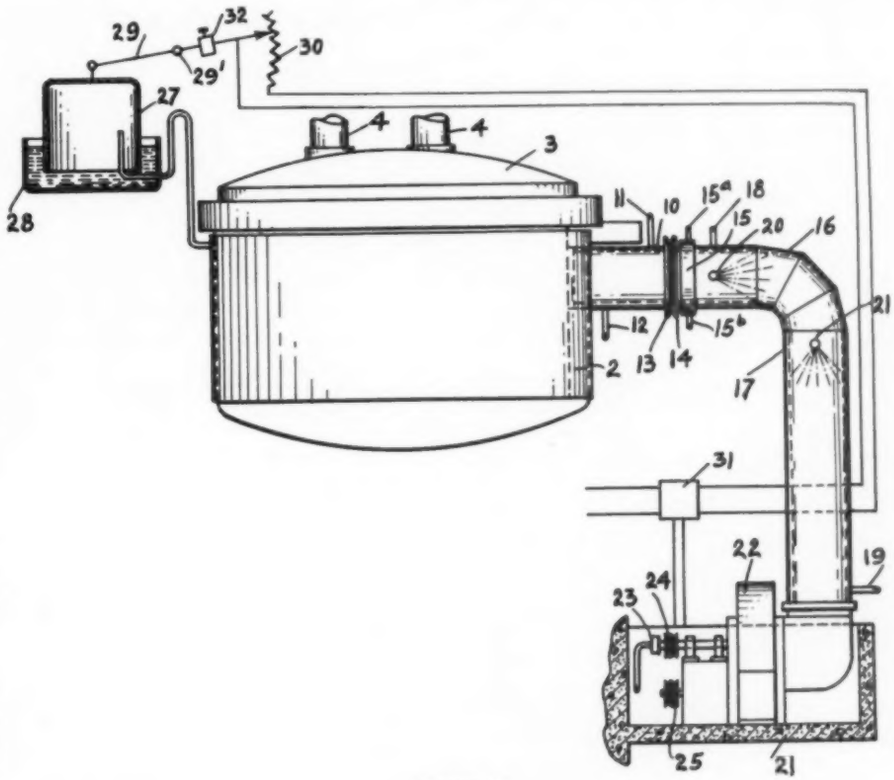


Figure 1

outlets. The end of the pipe 10 terminates in a wiper plate 13, the surface of which is a plane, but the edges of which may be curved back toward the furnace. When the furnace is in its horizontal or normal operating position, the plate 13 registers with a similar plate 14 on an adjustable collar 15, which is slidable along the end of a horizontal elbow 16 at the top of a downcomer pipe 17.

The collar 15 may be water-cooled, having inlet and outlet connections at 15a and 15b, and it is slidable on the end of the pipe 16 so that the plate 14 may be in close engagement with the plate 13. The downcomer pipe 16-17 may also be water-jacketed with a water inlet connection at 18 and a water outlet connection at 19. In addition to being water-jacketed, or in lieu of being water-jacketed, the downcomer pipe may be provided with internal spray nozzles for cooling the gases and protecting the pipe. Such nozzles are schematically illustrated at 20 and 21.

The pipe 19 is connected directly to a suction blower of the so-called Theissen type. Such a blower has a hollow shaft for receiving water at its driven or pulley end. From this inlet the water flows to the hub of the fan, and from the hub of the fan it is discharged out along the faces of the fan blades and whipped into a mist. In the drawing, 22 designates the fan, and 23 is the water connection at the pulley end of the fan shaft. 24 is the driving pulley, and 25 schematically illustrates the motor for driving the fan. The fan discharges into a combined flue and drain which passes under the floor of the pit to a point where it discharges to atmosphere.

During the time that the furnace is in operation, and hence generating fumes and smoke, the discharge nozzle 10 on the furnace is in alignment with the downcomer pipe, and there is a reasonably close fit between the face plates 13 and 14 so that the smoke and fumes may be drawn directly from the furnace. When the furnace is tilted, either for pouring of metal, or for slagging, the nozzle 10 moves out of alignment with the downcomer pipe, and at this time it is open to atmosphere.

The suction is regulated by an automatic control according to the changing needs as the melting cycle progresses. A flexible tube leads from the furnace and has its opposite end terminating under a bell float 27 which is in a receptacle 28 in which there is a body of water. As the pressure in the furnace changes, the change of pressure is communicated to the space within the bell 27, increasing or decreasing its buoyancy. As the bell rises or falls, it may be used to control the suction. The bell is connected to a lever 29 pivoted at 29′, which moves over a rheostat 30, which operates a variable speed control 31 for the variable speed motor 25 that drives the exhaust fan. Thus as the pressure under the bell increases, due to the increase in volume of smoke and gases, less resistance is imposed in the control circuit to cause the motor 25 to speed up, and as the pressure under the bell 27 decreases, more resistance is included in the circuit to reduce the motor speed. Adjustment of the control is indicated diagrammatically by a weight 32 adjustable along the lever 29.

REDUCTION OF IRON ORES WITH IMPROVED THERMAL EFFICIENCY

In ordinary processes for reducing iron ore, the thermal efficiency is low because the heat of the reduced material is not recovered. In U. S. 2,684,296, issued July 20, 1954 to Olav Moklebust, and assigned to National Lead Co., the reduced material is cooled with air. Oxidation is prevented by keeping the material covered with a layer of non-combustible oxidic material.

Crushed ore, coke, and limestone are fed into a tunnel furnace which consists of a pre-heating zone, a reduction zone, and a cooling zone. In the reduction zone, the temperature is about 1000 C. The mixed materials are placed in kiln cars in a layer about 4-in. thick, covered with a ½-in. thick layer of fine grained iron ore of size minus 20 mesh. About 2 hours are allowed for preheating, 2 hours for reduction, and 1 hour for cooling.

Heat is supplied by an oil burner, which provides an oxidizing atmosphere above the covering layer. In the heating zone, moisture and other volatile components escape through the porous covering layer. In the reduction zone, an intense evolution of CO from the charge occurs. The gas escapes through the porous covering and burns in the oxidizing atmosphere above it. Towards the end of the reduction zone, the covering layer sinters to a compact mass without the underlying charge sintering.

The material is then cooled in the cooling zone, by a flow of air drawn in from the discharge end of the furnace by a fan in the chimney at the feed end. The air is gradually heated, and then serves as the combustion air. The material is discharged from the furnace at about 100 C. The top covering is brittle and is broken apart by slight pressure. The underlying charge is then subjected to a separating process to remove unburnt coke and ash.

The inventor states that the degree of reduction is 92 per cent or higher.

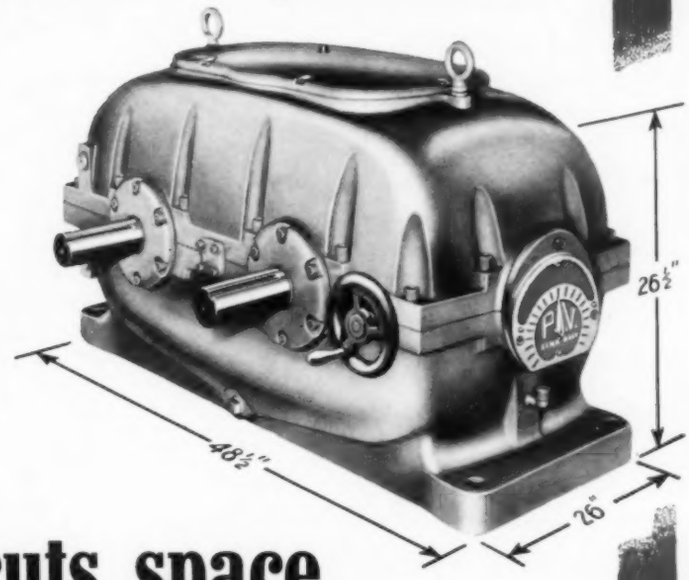
MULTIPLE ROLL PASS MILL

U. S. 2,684,000, issued July 20, 1954 to Raymond F. Holtz and assigned to Voss Engineering Co., relates to a combined roller leveler and multiple roll reduction mill for use in straightening sheets and plates and for reducing them where that is required.

In Figures 2 and 3, the numeral 1 designates a base having side frames 2 and a connecting yoke 3 at the top, the base 1 forming an extension beyond the side frames as shown in Figure 2 for mounting a drive motor 4 and transmission mechanism 5. A side bracket 6 extending from the frame members 2 constitutes a support for a drive transmission 7 from which a pair of drive shafts 8 and 9 extend, as shown in Figure 4. A number of sprocket shafts 10 and 11 are mounted in a cross member 13 and a similar pair of shafts 14 and 15 are mounted in a cradle 16 that is supported on a complementary shaped support 17 to be tiltable on it. A pressure block 18 is provided in the top of cross member 13 and a pressure block 19 in the cradle 16, the pressure blocks extending the full length of chain rollers 20 and 21. Cradle 16 is provided with a fulcrum 22 connected by a pin 23 to a rod 24 and may be moved by the wheel 25. The cradle support 17 is adjustable vertically in ways 26 on the side frames 2 by a wedge 27 through the adjusting wheel 28. Tables 29 and 30 are provided to support the material passing between the rollers 20 and 21.

As shown in Figure 4, shafts 8 and 9 are provided with coupling mem-

LINK-BELT 25-hp P.I.V. Variable Speed Drive



cuts space requirements up to 50%

LINK-BELT gives you all the advantages of positive, stepless speed changing in high horsepowers, too

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The Size 6 P.I.V. is built in three types: The basic drive . . . with input *or* output gears . . . with input *and* output gears. All are available in a wide range of ratios, 20 to 25 hp.

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P.I.V. LINK-BELT VARIABLE SPEED DRIVE

13.594

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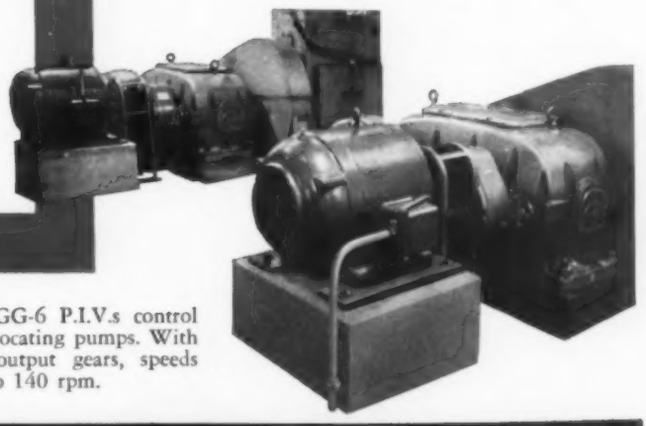

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4 OF 16 P.I.V. TYPES
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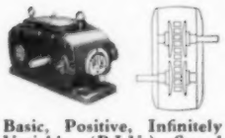
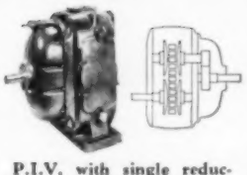
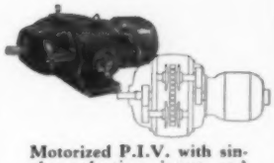
½ TO 25 HP—
RATIOS TO 6:1



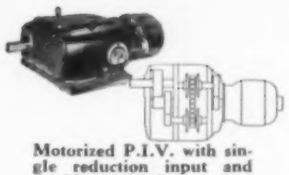
Basic, Positive, Infinitely Variable (P.I.V.) Speed Drive.



P.I.V. with single reduction input or output helical gears.



Motorized P.I.V. with single reduction input and output helical gears.



Motorized P.I.V. with single reduction input and double reduction output helical gears.

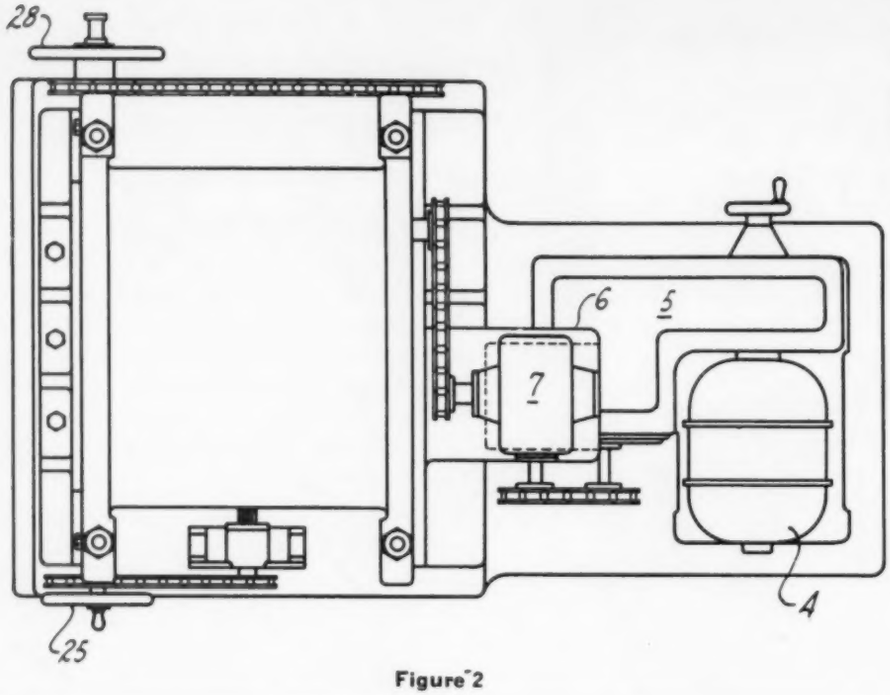


Figure 2

bers 31 and 32 having universal joints 33 with connecting links 34 driving couplings 35 and 36. Coupling 35 may be a plain sleeve with a universal joint 37 as shown in coupling 36. Couplings 35 and 36 are respectively connected to drive shafts 11 and 15, which are each provided with a pair of sprocket wheels 38, 39 and 40, 41, respectively, the sprockets being keyed on their respective shafts as shown. Shafts 11 and 15 are journaled in the cross member 13 and the cradle 16 as previously explained.

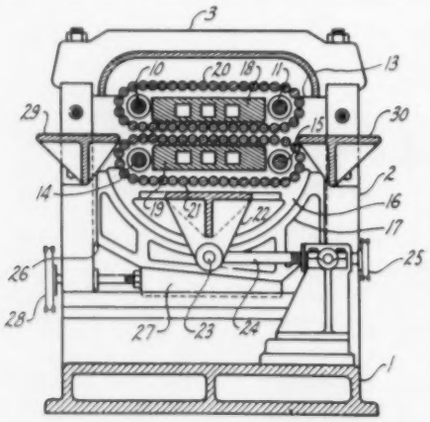


Figure 3

The coupling 36 is a split member and consists of the part designated by the reference numeral 36 and the coupling 36a, the parts being connected by bolts 42. To make the drive shaft 11 angularly adjustable relative to the drive shaft 15 for the purpose of converting the apparatus from a roller leveler to a reduction mill as shown in Figure 3, the coupling member 36a has its bolt holes 43 elongated as shown in Figure 5, the elongation being approximately 18 degrees and the shifting of the coupling on the bolt a distance from one end of the slot 43 to the other is sufficient to index the sprocket wheels 38 and 39 one tooth, the pitch of the sprocket chain being such that a half-tooth adjustment of the sprocket wheels 38 and 39 will bring the rolls 20 and 21 in vertical alignment when one end of the slot 43 abuts the bolts 42, and in staggered relation when the other end of the slot 43 abuts bolts 42.

Thus, by using this adjustable coupling, a roller leveler may be converted to a multiple pass mill or vice versa.

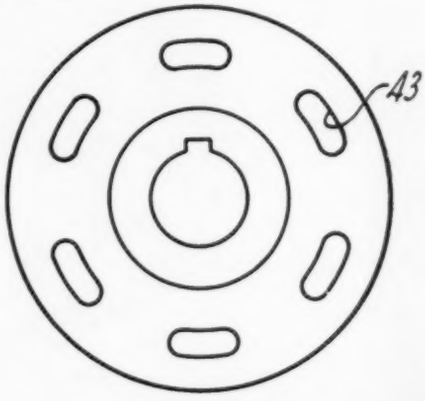


Figure 5

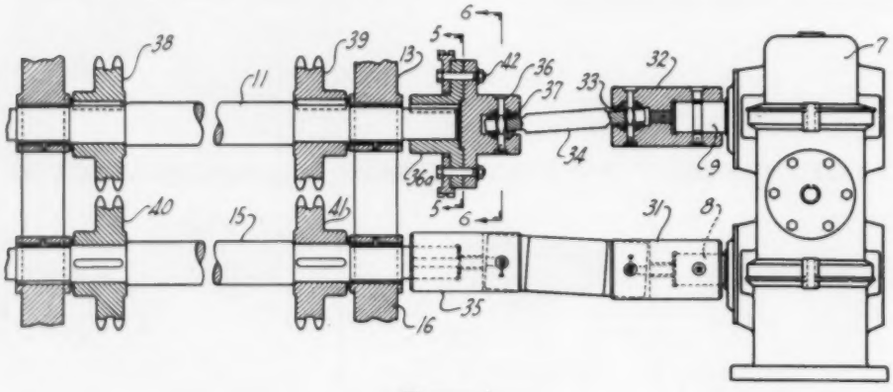


Figure 4

OPEN HEARTH AIR UPTAKES

A modified form of air uptakes for open hearth furnaces is described by Franz Bartu and Alfred Slesaczek in U. S. 2,685,439, issued August 3, 1954 and assigned to General Refractories Co.

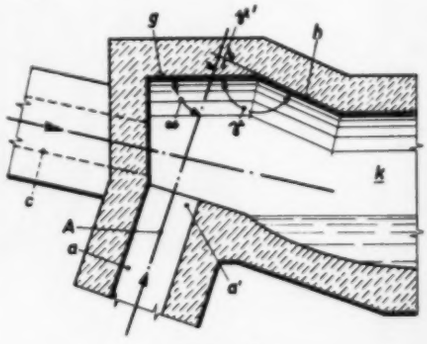


Figure 6

As shown in Figure 6, the angle between the uptake axes and the roof is about 70 degrees. It is claimed that this greatly reduces the tendency to spread the flame excessively or to break up the flame. As a result, it is possible to use smaller gas or oil inlet velocities or higher air velocities.

SMELTING OF IRON ORE WITH COAL

In U. S. 2,684,897, issued July 27, 1954 to Otto Dietrich, assigned to

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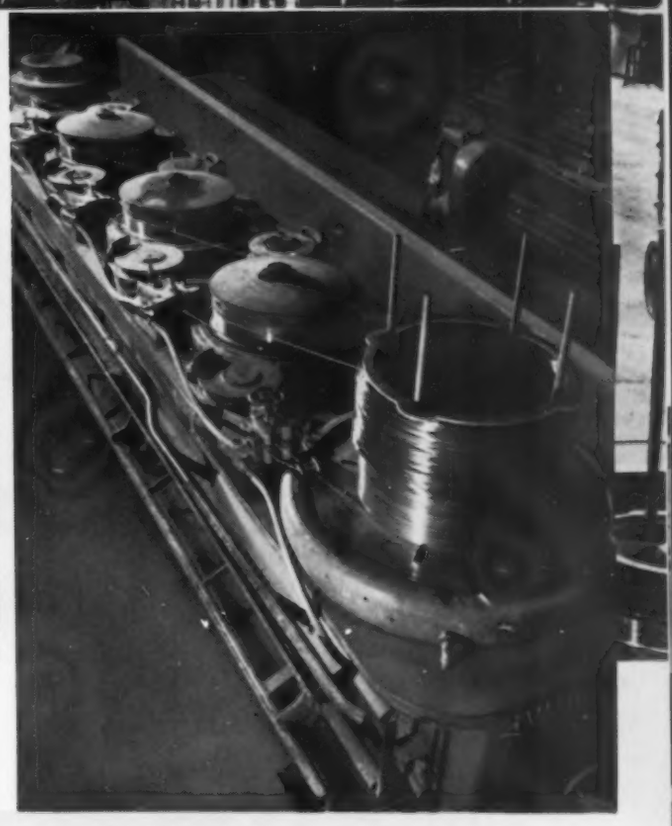

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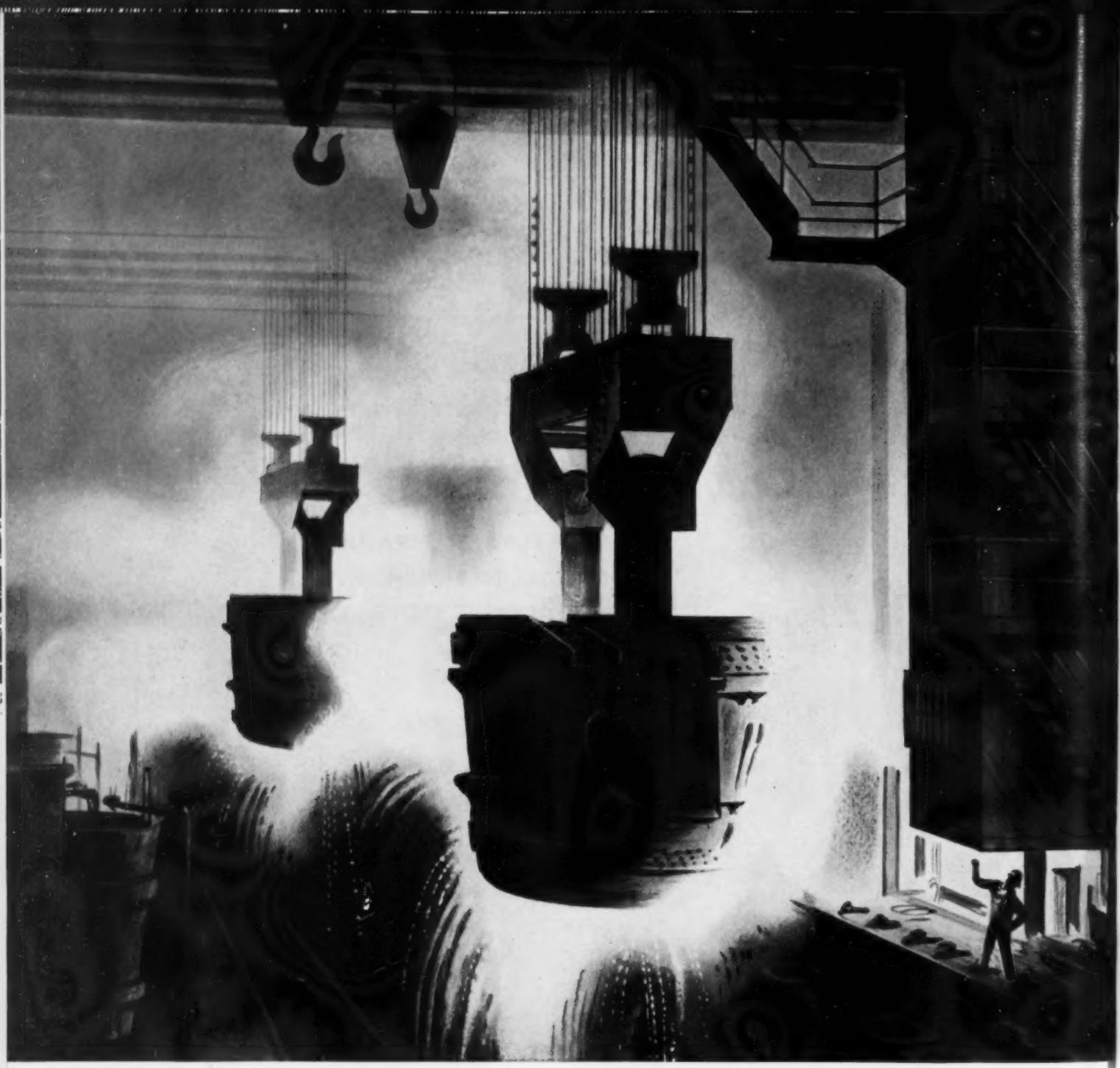

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MORGAN ENGINEERING *of* ALLIANCE, OHIO

THE MORGAN ENGINEERING COMPANY, ALLIANCE, OHIO

Klochner-Humboldt-Deutz, A. G., a method of smelting iron ore briquetted with low-grade coal is described. In addition to utilizing coal otherwise unsuitable for smelting purposes, the coal is coked simultaneously in the furnace and by-product vapors are recovered.

Small blast furnaces are used, about 12 ft wide and having a charge height of only 6 to 18 ft. Because of the short charge height, it is possible to use for briquetting a binding agent tending to become soft, such as pitch.

The hot gases evolved from the coal in the upper zone of the blast furnace are subjected to fractional distillation, yielding a thick tar which is useful as the binding agent for briquetting, and also a thin tar.

The process and apparatus used are described in some detail in the patent.

OTHER PATENTS OF INTEREST TO THE IRON AND STEEL ENGINEER

Patent No.	Date	Subject	Inventor or Assignee
2,683,570	7/13/54	Coiler for coiling hot strip-metal delivered from rolling mill	John F. Ferm
2,683,677	7/13/54	Method of precipitation hardening iron alloys	Francis M. Walters, Jr. and Irwin R. Kramer
2,683,988	7/20/54	Temperature measurement of molten metal	Leeds and Northrup Co.
2,684,001	7/20/54	Automatic screw-down control in combination with a rolling mill stand	Olin Industries, Inc.
2,684,073	7/20/54	Quenching machine	Hendrick J. Gregg
2,684,291	7/20/54	Process for producing embossed designs on hard surfaced rolls	Sharon Steel Corp.
2,684,298	7/20/54	Austenitic stainless steel	Allegheny Ludlum Steel Corp.
2,684,605	7/27/54	Cooling bed for products from a hot working rolling mill	Birdsboro Steel Foundry and Machine Co.
2,684,681	7/27/54	Conveyor and quench tank for heat treating furnaces	Sunbeam Corp.
2,684,900	7/27/54	Intermediate alloy and process for forming wear-resistant cast iron	General Motors Corp.
2,685,216	8/ 3/54	Protective device for tube mills	United States Steel Corp.
2,685,359	8/ 3/54	Method of handling and assorting hot-dip tin plated sheets	United States Steel Corp.
2,685,418	8/ 3/54	Automatic strip starter	George W. Moore et al.
2,685,562	8/ 3/54	Coke oven with electrically-controlled gas recirculation means	Franz Trefny
2,685,672	8/ 3/54	Apparatus for magnetic detection of flaws in ferromagnetic pipe	Tuboscope Co.

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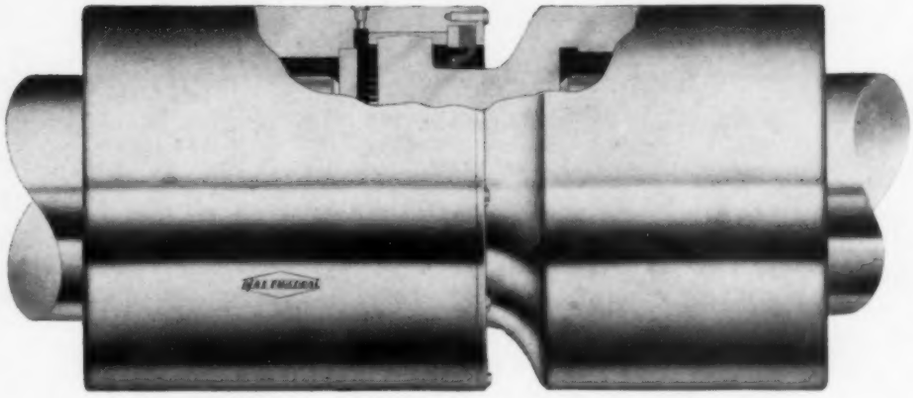

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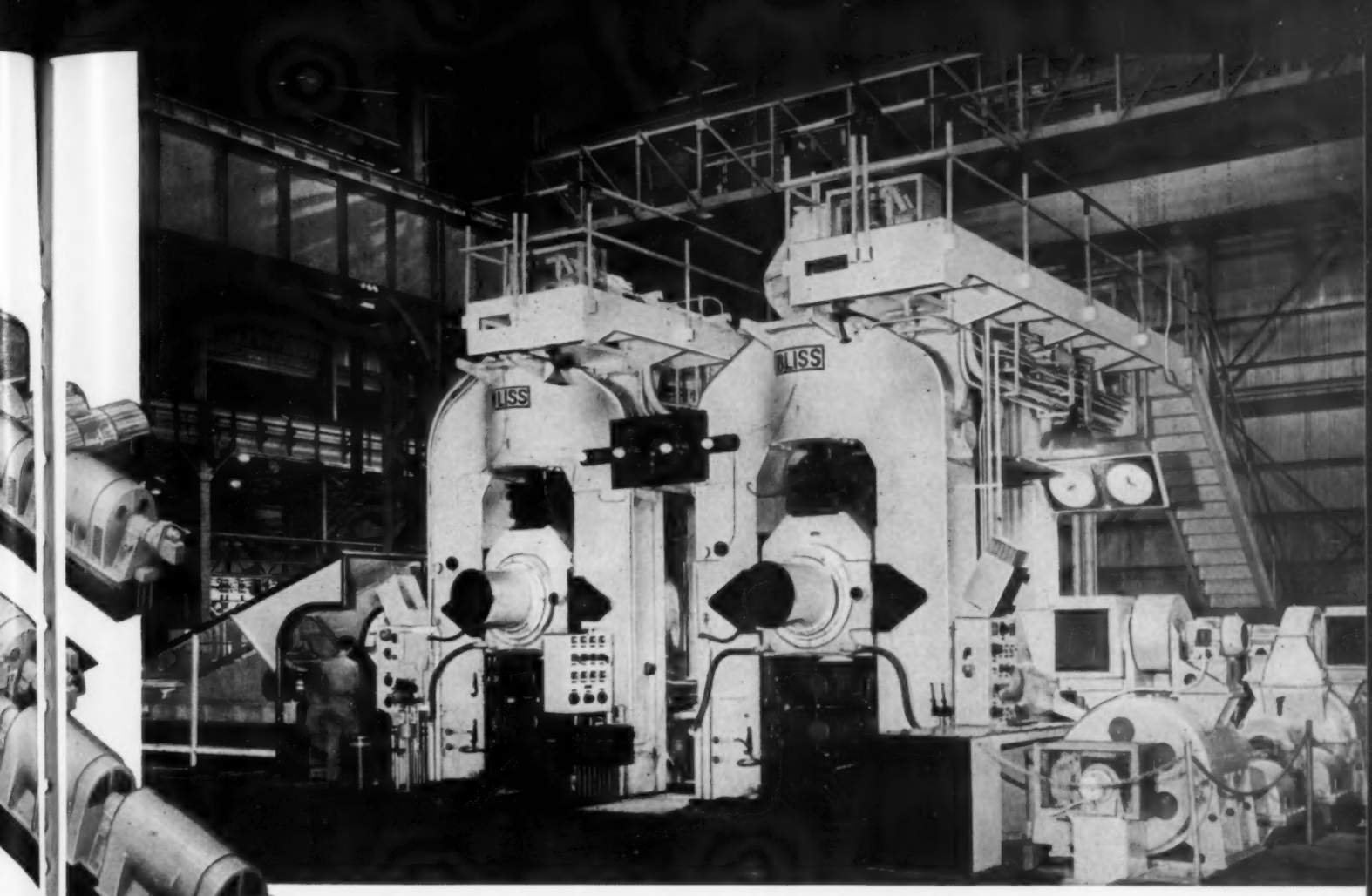

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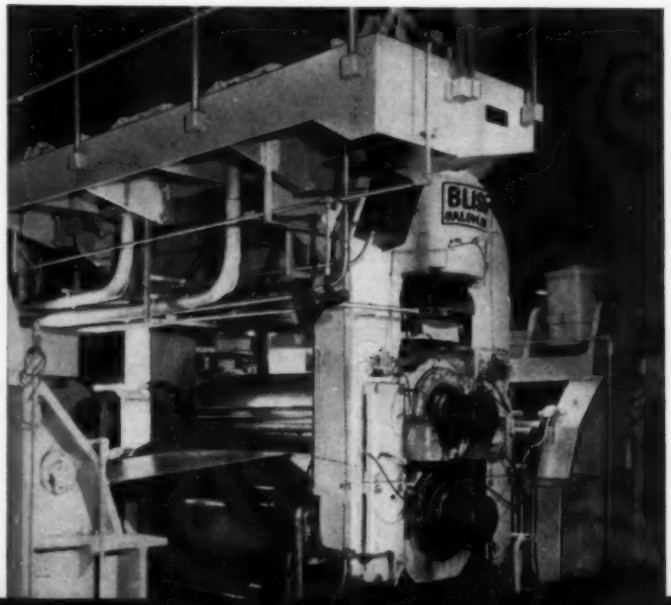

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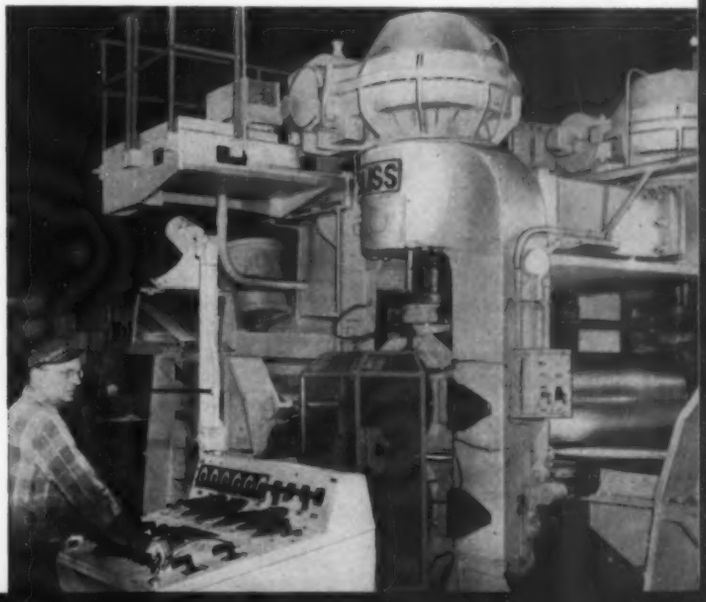

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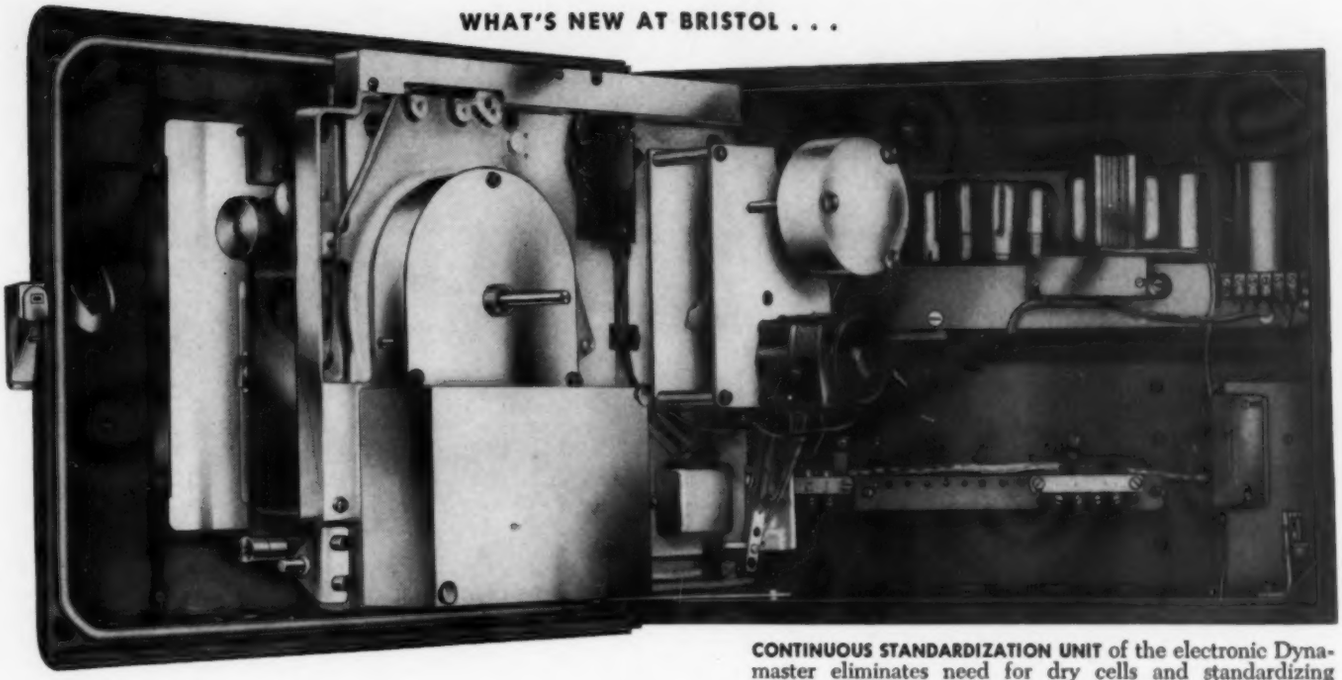

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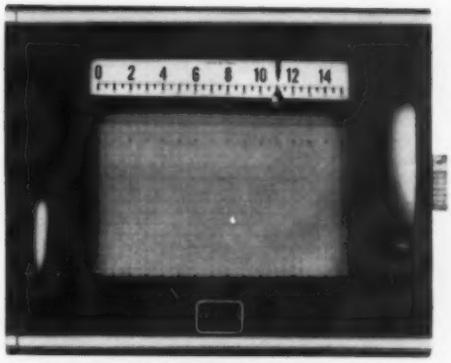
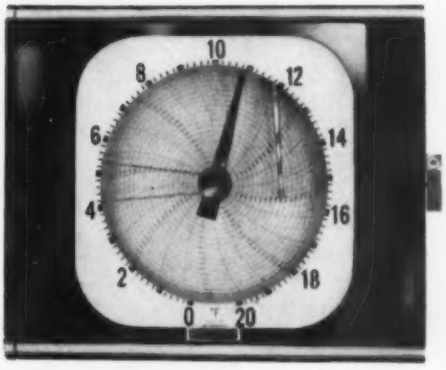


BRISTOL DYNAMASTER CONTROLLERS in either the strip-chart model (shown above) or round-chart model, may be electrically or air operated. 2 position, 3 position, proportional, manual with automatic reset, or proportional input controls. On - off, proportional or reset air controls.



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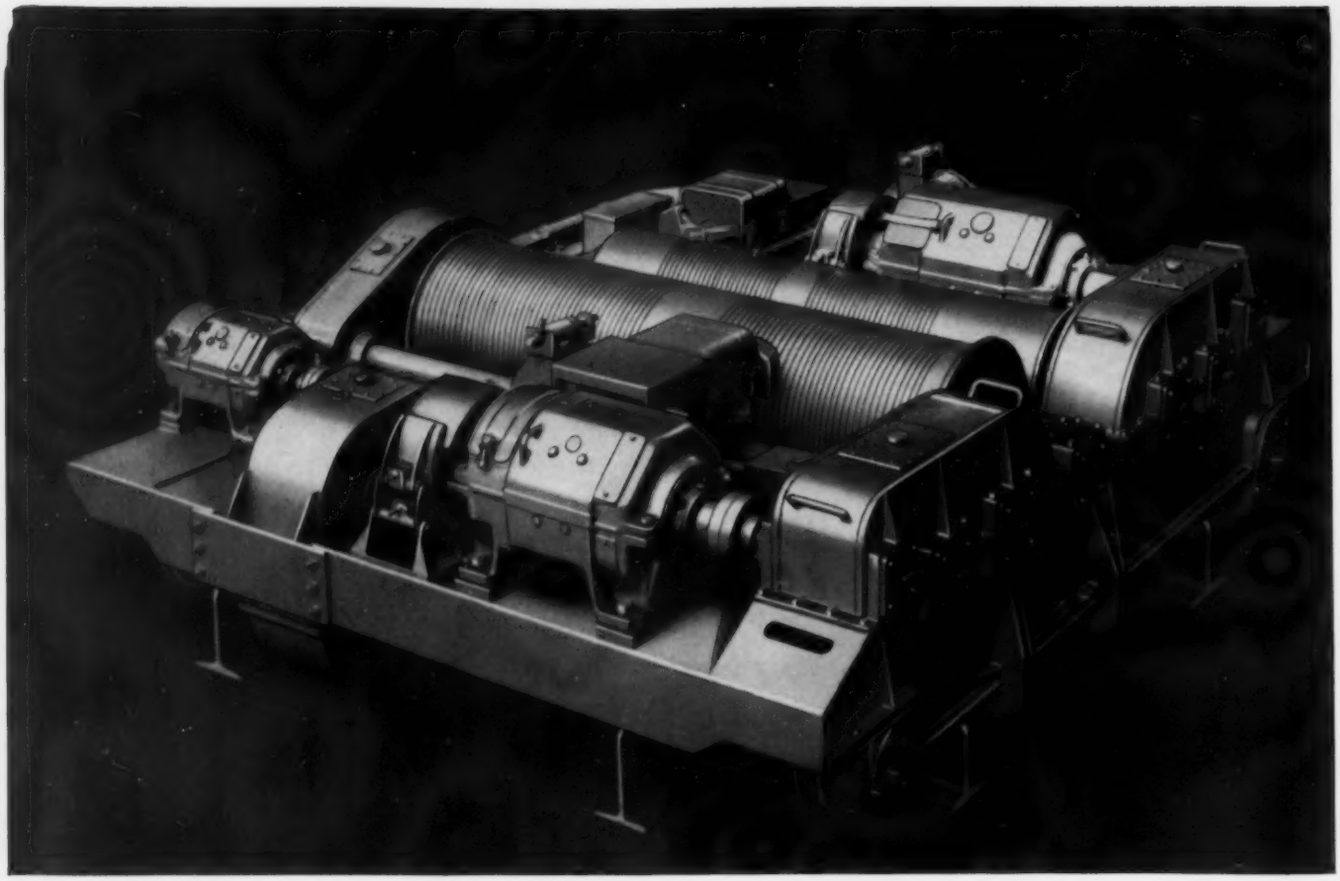
AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS



VICTOR R. BROWNING *Trolleys*

FOR HEAVY DUTY MILL TYPE CRANES

"Simple Design is Sound Design"

We offer a complete line of trolleys built to meet the most exacting requirements. These trolleys are constructed of the finest materials available. No cast iron is used. All shafts are of highest quality alloy steel. All bearings are calculated with a proper life factor for service required as defined by the A. I. S. E. We will build a trolley to fit your special requirements as to gauge, head room, approaches and general arrangement. We also make a complete line of cranes for steel mill use. . . Your inquiries will be welcome.

VICTOR R. BROWNING & COMPANY, Inc.

BOX 309, WILLOUGHBY (CLEVELAND), OHIO

Designers and Builders of Electric Overhead Traveling Cranes and Hoists and Electric Revolving Cranes

Exit end of high speed tinning line.

The Wean Engineering Company, Inc., Warren, Ohio is a recognized specialist in the design and installation of sheet, tin and strip mill equipment. The expert knowledge and trained imagination of one of the world's most noted steel mill engineering firms are at your service when you specify Wean — whether the job calls for a single piece of equipment or a complete design of an entire line.

The WEAN

ENGINEERING COMPANY

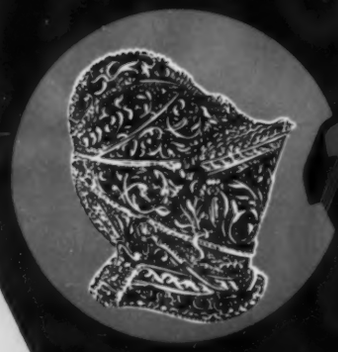
INCORPORATED

Warren, Ohio

Special metal working equipment . . .

DESIGNING AND BUILDING TOMORROW'S METAL WORKING MACHINERY IS THE BUSINESS OF

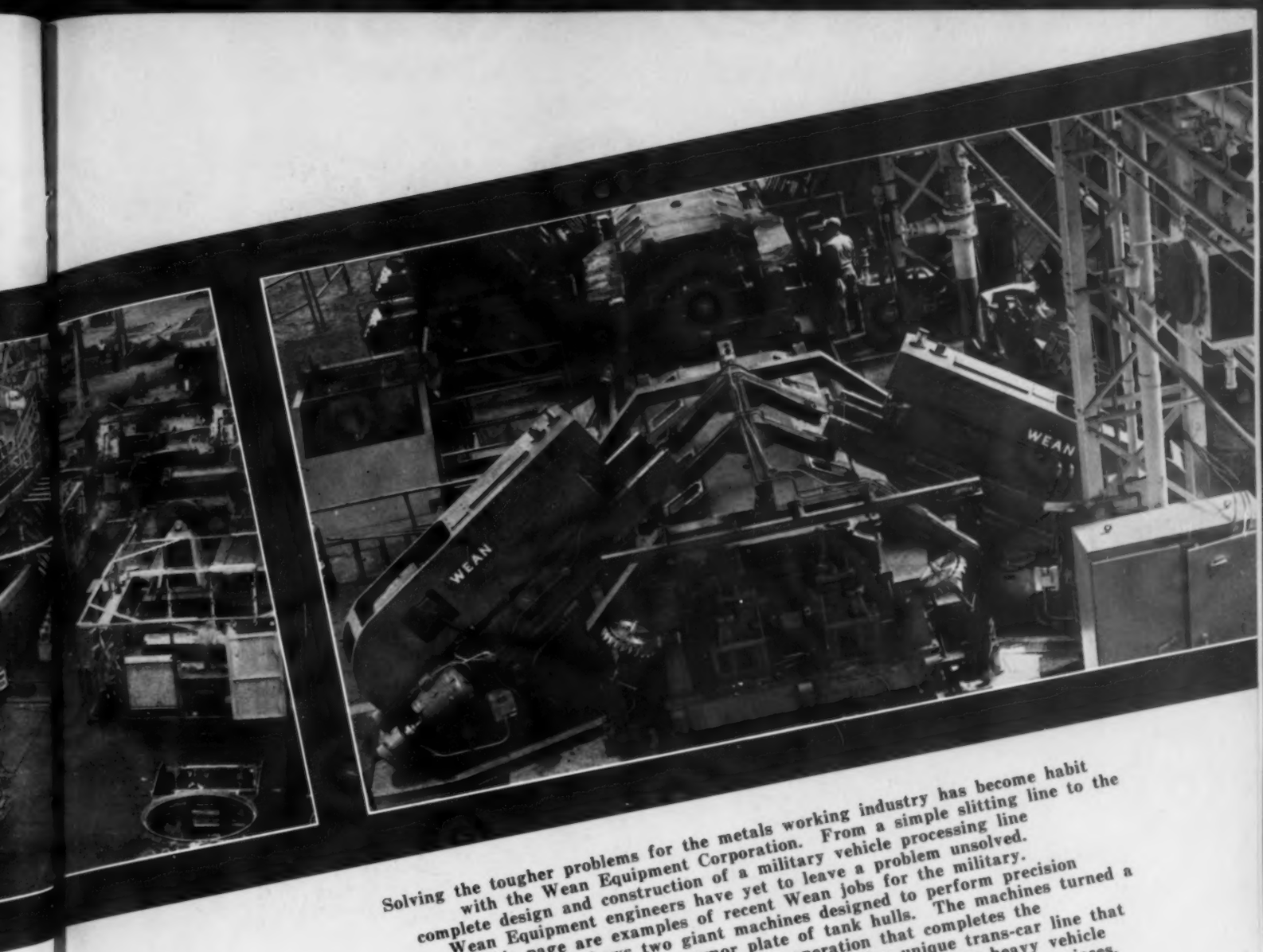
Wean advanced slitting and flying shear line . . .



EQUIPMENT CORPORATION

Wean

veland, Ohio



Solving the tougher problems for the metals working industry has become habit with the Wean Equipment Corporation. From a simple slitting line to the complete design and construction of a military vehicle processing line Wean Equipment engineers have yet to leave a problem unsolved.

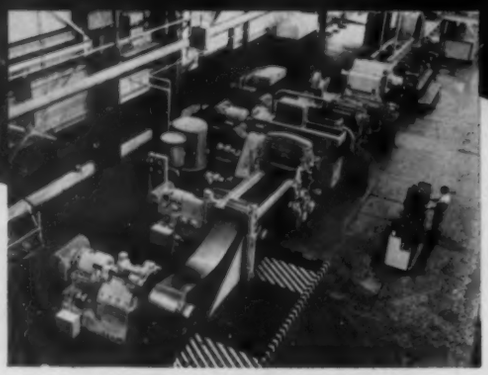
On this page are examples of recent Wean jobs for the military. The top photograph shows two giant machines designed to perform precision grinding and drilling on the armor plate of tank hulls. The machines turned a slow, hand process into a production operation that completes the job 22 times faster. The bottom photograph is of a unique trans-car line that performs precision milling, drilling and boring operations on heavy vehicle hulls . . . at the same time solving the handling problems of these bulky pieces.

When you have a job that requires special machinery—large or small—you'll be wise to call in a Wean Equipment engineer.

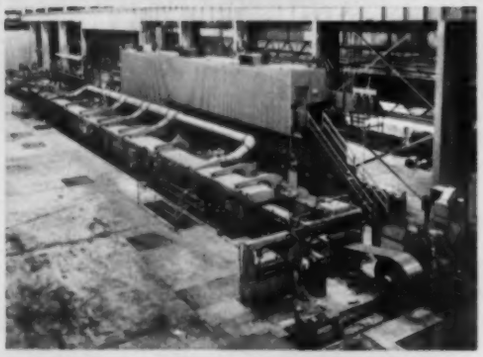
Here's the most advanced flying shear line marketed today. A line that can save you up to 20 per cent on your steel costs because it can make 100 cuts-per-minute to resquared tolerances. If you are a user of sheet steel it will more than pay you to get in touch with a Wean Equipment engineer and have him prove to you how you can order your steel direct from the mill, in coil form, eliminate expensive extras, and make a saving amounting to almost $20 per ton in your final steel costs. You can't afford to overlook this

WEAN ENGINEERS are recognized specialists in the design and installation of sheet, tin and strip mill equipment...

Wean High Speed Electrolytic Cleaning Line



Continuous Coating Line



Electrolytic Cleaning Line

Continuous Strip Pickle Line

ASSOCIATE COMPANIES

Wean Equipment Corporation	Cleveland, Ohio
The McKay Machine Company	Youngstown, Ohio
Flinn & Dreffein Engineering Co.	Chicago, Illinois
The Hallden Machine Company	Thomaston, Connecticut
The Drever Company	Philadelphia, Pennsylvania
The Wean Engineering Co. of Canada, Ltd.	Hamilton, Ontario

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THE WEAN ENGINEERING CO., *Inc.*

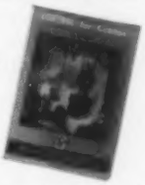
Warren, Ohio

Check the facts . . . facts obtained from experience of many installations . . . and you will agree that EC&M skip hoist Control gives smoother, more efficient performance under all conditions.

Experience shows that EC&M Control for skip hoists allows high speed output on the incline, and assures accurate stopping, regardless of the weight in the bucket.

Simplicity of design makes initial cost surprisingly low . . . and minimizes maintenance.

When considering a new installation or improving existing facilities, call the nearest EC&M office for complete control engineering service.



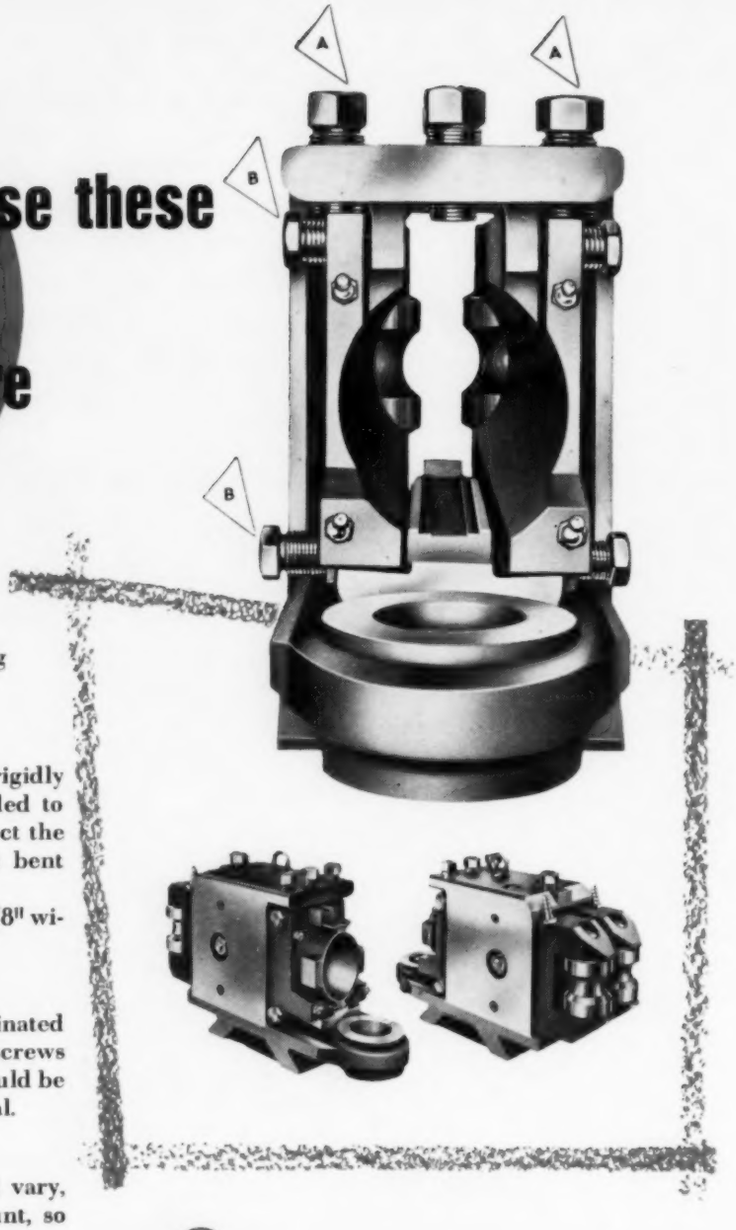
Write today for Booklet 921-SK

J&L AGAIN SPECIFIES
EC&M CONTROL FOR
BLAST FURNACE
SKIP HOIST

5038

THE ELECTRIC CONTROLLER & MANUFACTURING CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

8 good reasons why you should use these ROLLER GUIDES in your bar or wire rod mill



The Morgårdshammar Roller Guides — patented in most countries of industrial importance — are constructed according to the following principles:

1 The entry friction guides are rigidly clamped into the guide box. They are intended to lead the oval to the groove in the roller, to protect the rollers against overloading, and to straighten bent rods.
The groove in the entry guides is made about 1/8" wider than the oval.

2 The rollers are mounted on laminated springs, which can be adjusted by means of the screws "B", and hold the oval steadily even if there should be some slight variation in the thickness of the oval.

3 If the thickness of the oval should vary, the springs of both rollers yield an equal amount, so that the oval remains in the centre of the groove.

4 To tilt the oval, the screws "A" are adjusted as shown by the arrows. One roller will then be lifted as much as the other is lowered.

5 As the oval is held very rigidly, the leader oval for wire rod may be thick, unless other circumstances call for a thinner oval.

6 The roller guide assemblies are narrow, and all screws that require adjustement during rolling are accessible from the front of the mill. No lateral space outside the guide box is therefore required for gaining access to the set screws, and the guide box assembly can thus be located close to the mill housing.

7 As the groove in the entry guides is wide and nothing but rolling friction acts on the oval, the latter is very easily introduced into the pass, and there is practically no risk of scratching the bar.

8 The roller guide may be used not only for leader and drawing oval passes but also for edging flats as well as for rolling squares, hexagons, octagons and various other sections, for instance in reduction passes for hexagon. It is suitable for all types of rolling mill. An important advantage is that the roller guide enables repeaters to be used in rolling thick leader-ovals.

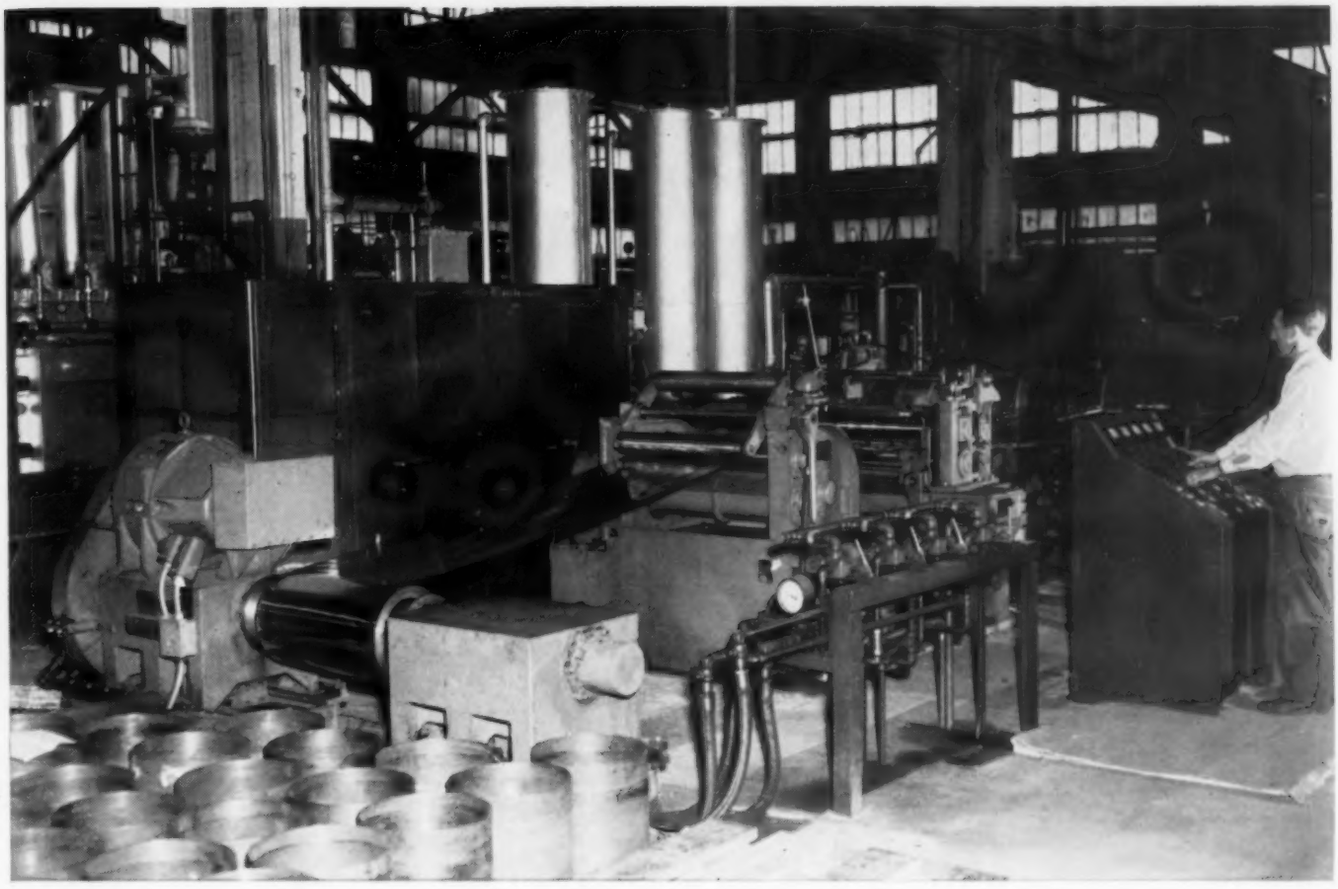
P.S. *Practically speaking, every bar and wire rod mill in Scandinavia uses roller guides of our design.*

MORGÅRDSHAMMAR

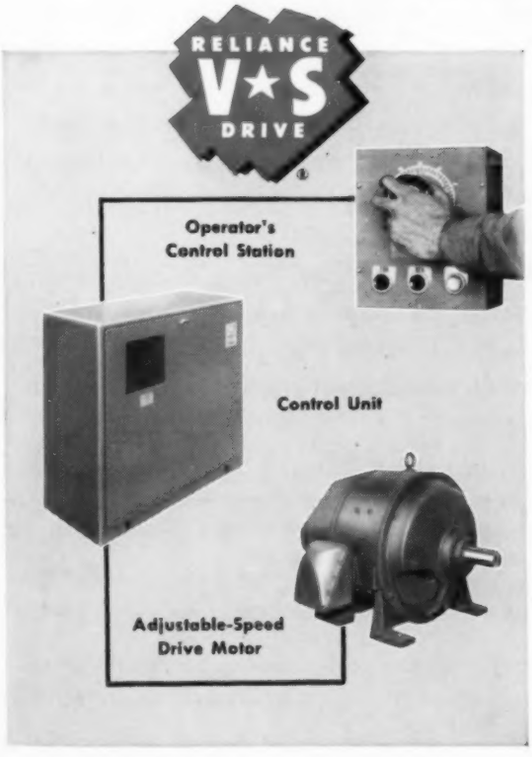
MORGÅRDSHAMMARS MEK VERKSTADS AB • MORGÅRDSHAMMAR • SWEDEN

Telegrams: Morgårdshammar, Ludvika

For the complete story — send for your copy of bulletin L3—1E.



For Fast Production at Lowest Cost Use A Reliance V★S Drive



Throughout the steel industry, Reliance V★S Drives are providing the accurate controls necessary for cost-cutting, automatic operation of processing lines. In addition, these drives afford worthwhile savings of their own. For instance, they can be placed adjacent to process lines doing away with heavy cable runs from motor rooms to drive units. Factory-installed wiring between generating equipment and control units eliminates time-consuming field installation. Further savings are realized because every Reliance V★S Drive is tested at the factory, minimizing field checking and start-up time.

Reliance V★S Drives are available up to 300 hp. They are simple to operate and easy to maintain. And you can place them exactly where you want them.

We would like to tell you more about the savings these drives have to offer. Write and tell us when you would like to talk it over. D 1488

RELIANCE ELECTRIC AND ENGINEERING CO.

1084 Ivanhoe Road, Cleveland 10, Ohio • ***Sales Representatives in Principal Cities***

Modern Steel Makers Maintain Control with RCA Industrial TV

Production records are being made through mill supervision by RCA Industrial TV... On an 80" mill that holds the world's record for hot strip, a camera over the mill and a TV screen on the control pulpit permit the operator to detect threats of pile-ups, or other troubles, before damage occurs. One pile-up on a strip mill can mean as much as 15 minutes of lost production time or 120 tons of steel . . . so it pays off handsomely to KNOW, not GUESS.

Many Uses. Other uses include RCA Industrial TV to observe furnace conditions, heat treating, charging, crane movement, and other hazardous or inaccessible operations . . . wherever it's important to *see* where you cannot *look.*

Direct-Observation Clarity. With RCA Industrial TV you attain the accuracy of direct observation without danger or inconvenience. You see a high-definition, high-contrast picture that's best for efficient centralized control, and all camera adjustments are conveniently made at the viewing monitor.

Survey Without Obligation. Let us make a survey of your Industrial TV requirements without obligation. RCA's practical Service Plan provides for service by experienced factory-trained engineers. Use coupon below for literature.

RCA CAMERA... compact, rugged, built to give reliable service under rough operating conditions. Uses the sensitive RCA-developed time-proved Vidicon tube, reducing weight to a minimum.

RCA MONITOR... shows stable, high-definition picture, assures accurate reproduction of fine details. For convenience and ease of operation, all controls for camera and TV are located on control monitor.

ACCESSORIES... include water-cooled camera lens, explosion-proof housing, panel-mounting monitor, camera switcher, industrialized auxiliary viewer, remote iris, remote focus, pan and tilt assembly and other field-proved equipment.

New Low Prices Now in Effect!

RCA

RADIO CORPORATION of AMERICA

CAMDEN, N. J.

In Canada: RCA VICTOR Company Limited, Montreal

Radio Corporation of America
Dept. K-188, Building 15-1, Camden, N. J.

Please send me latest brochure on use of RCA Industrial TV in steel mill operations.

Name.....Title.....

Company.....

Address.....

City.....Zone.....State.....

Announcing the Clark-Ross Y-200

Designed specifically for 20,000 lb. jobs!

CHECK THESE FEATURES:

Heaviest uprights in the industry: Hi-tensile steel channel specially rolled for this truck.

Shortest turning radius: 15 feet; shorter than any other comparable truck.

3 in. thick steel steer axle.

10 in. underclearance at uprights, plus excellent weight distribution, permit operations under most severe yard conditions.

Safety check-valve built-in: a Clark-Ross exclusive; impossible to drop the load because of line failure.

Planetary gear drive: takes the strain off the axle; all drive components protected.

Extremely easy to service: hydraulic cylinder serviced from bottom, no need to remove uprights; engine and hydraulic system easily accessible.

From the ground up, the Y-200 is a genuine 20,000 lb. truck—not merely a beefed-up truck of less capacity. Pre-production models have been job-tested for nearly a year at steel mills, sawmills and wood treating yard.* These trucks have proved their ability to cut handling costs under the toughest conditions. We are frank to say that we believe the Y-200 will give you better performance, at less cost, than any comparable machine. We invite your comparison: Simply call your local Clark dealer, listed under "Trucks Industrial." Or write us direct. There's no obligation.

*Names supplied on request.

CLARK EQUIPMENT

ROSS CARRIER LINE
Industrial Truck Division
CLARK EQUIPMENT COMPANY
Battle Creek 135, Michigan
☐ Send details on Y-200

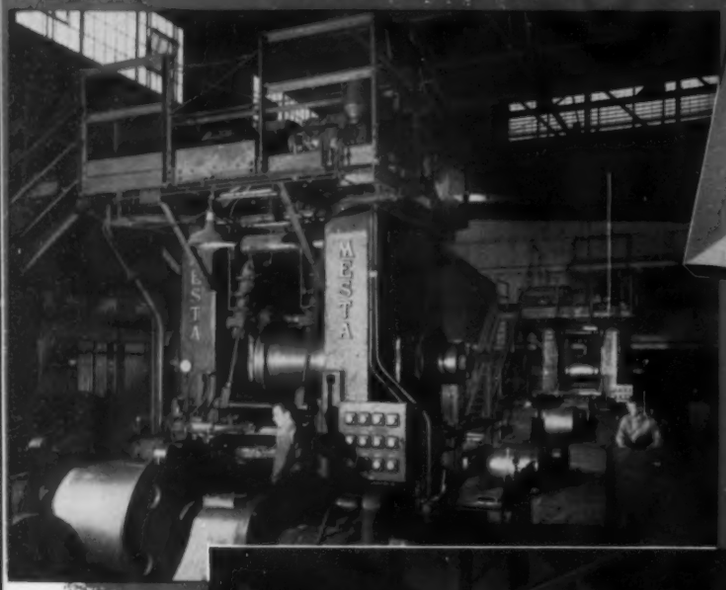
Name_____

Firm_____

Address_____

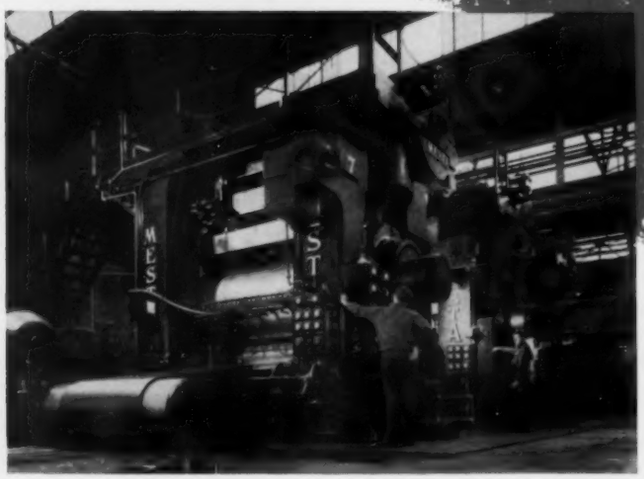
City_____ Zone_____ State_____

Designed and Built by MESTA



42" Four-High Skin Pass
Mills for Tin Plate

96" Four-High Continuous
Hot Strip Mill Finishing Stands

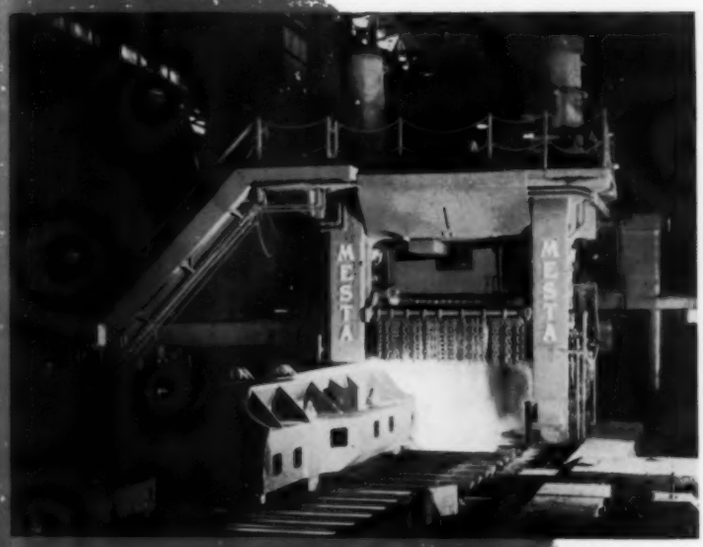


93" Four-High Three-Stand
Tandem Cold Mill

32" Mesta Patented
Pickling Machine

for JONES & LAUGHLIN STEEL CORPORATION

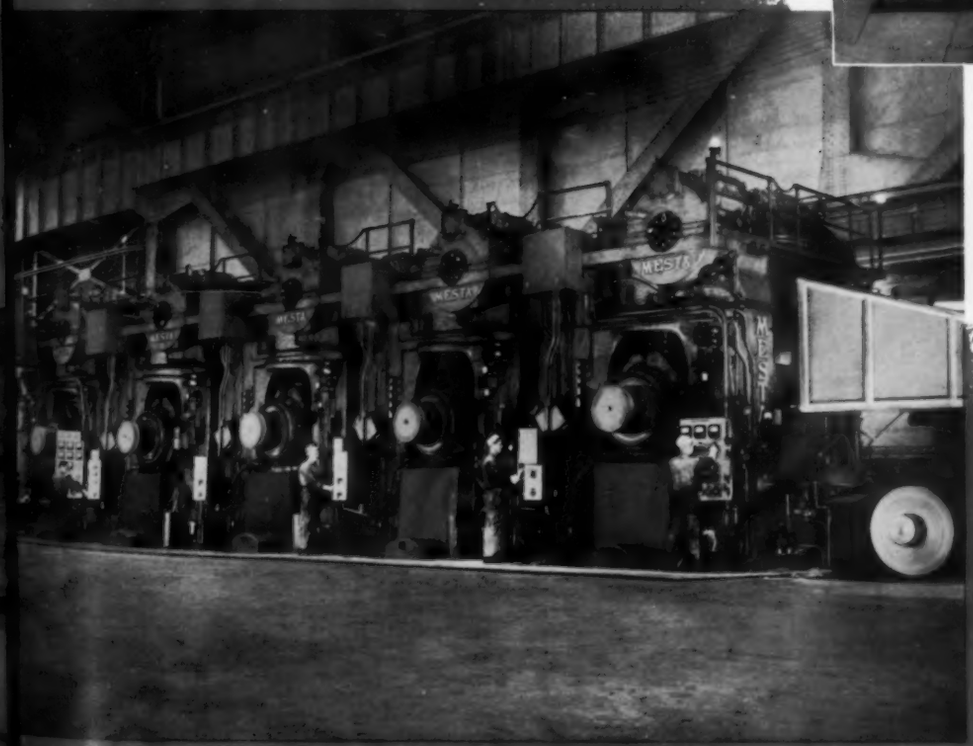
Pittsburgh, Pa.



46" Reversing Slabbing-Blooming Mill

93" Continuous Pickling Lines for wide strip

42" Four-High Five-Stand High-Speed Tandem Cold Mill



42" Tin Shearing Line with Trimmer and Combination Flying Shear and Leveller

Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

Announcing ...New **Ohio** Shop-Lifter

SELF-CONTAINED, BATTERY-OPERATED MAGNET FOR IN-PLANT USE

Ohio Shop-Lifter Magnet is the newest, latest thing for magnetically handling high-density loads such as large chunks or machined parts. Powered by long-life, self-contained batteries, it can be used indoors because it eliminates the dangers of sudden power failure.

Powerful? Lifts up to 2000 pounds. *Light?* Weighs only 120 pounds; ideal for use on lift trucks or portable shop hoists. *Maintenance?* Batteries last five to 12 average work shifts without recharging. Remote control optional.

Call or write Ohio Electric for information on the new Ohio Shop-Lifter and request Catalog 113.

AA-244

OHIO WELDED MAGNETS. 39 to 65" diameter. Lightweight models in 39 & 45". 6-coil types in 46, 55, 65"; 8-coil in 55 & 65". Weld on top where it can't get dented in. Also capsule coil over 45".

Ohio gives prompt service in rebuilding and reconditioning magnets

OHIO BOLTED MAGNETS. 12 to 65" diameter. 6-coil types in 39 to 65"; 8-coil in 55 & 65". Strap copper coils over 39". Bolts protected in recessed wells. Also capsule coil over 45".

OHIO BASKET MAGNETS. 55 & 65" 4-coil, & 65" 6-coil. For extra heavy-duty service; hefty ears project beyond magnet diameter, ward off damaging blows. No weight carried by bolts. Also capsule coil over 45".

CHESTER BLAND
President

ohio ELECTRIC

THE OHIO ELECTRIC MFG. CO.

5400 Dunham Rd. • Maple Heights • Cleveland, Ohio

Top: Clark Control Center for furnace control at Bohn Aluminum and Brass Corporation, Adrian, Michigan.

Insert: Separate access doors to vertical wireways simplify installation, inspection, service and maintenance.

SEPARATE VERTICAL WIREWAYS

Simplify installation and servicing of

CLARK CONTROL CENTERS

Roomy 6-inch wide vertical wireways for each section, independent of starter compartments and equipped with separate access doors, save time and money on installation of Clark Control Centers, and make them easier to service and maintain.

Ample wiring space is provided for all load and interwiring connections. Terminal boards may be located in vertical wireway adjacent to starters or at top or bottom of any section. Versatile bus-bar compartments permit the use of one to four sets of electrically isolated horizontal bus, permitting power to be fed from any or all of four different sources.

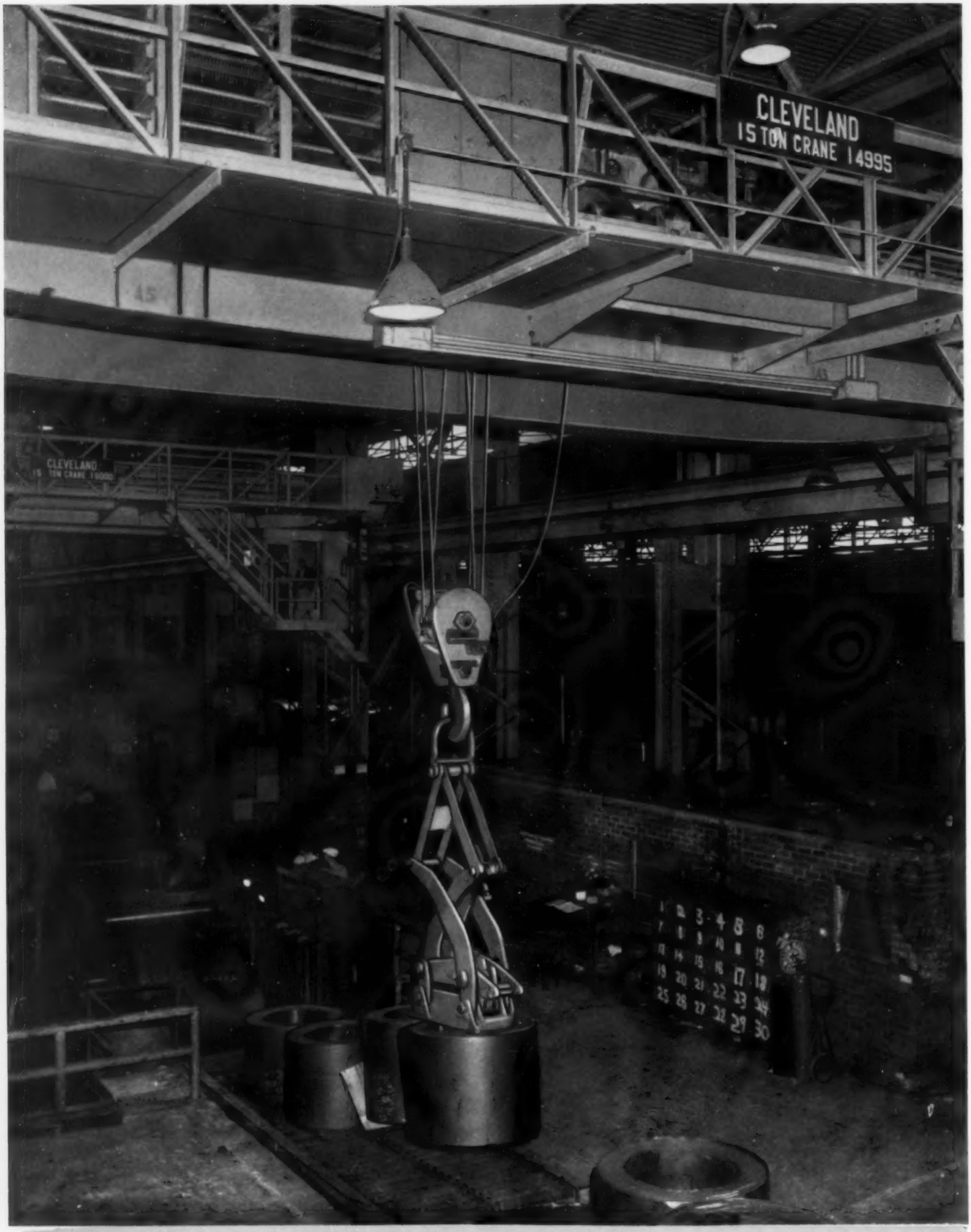
Clark Control Centers are the easiest to pre-plan and lay out because adding transformers and/or relays or changing type of construction (NEMA type A, B, or C) does not change space requirements.

Write for your copy of the 24 page illustrated book entitled "Control Centers by CLARK."

The **CLARK** **CONTROLLER** *Company*

Engineered Electrical Control

1146 East 152nd Street • • Cleveland 10, Ohio

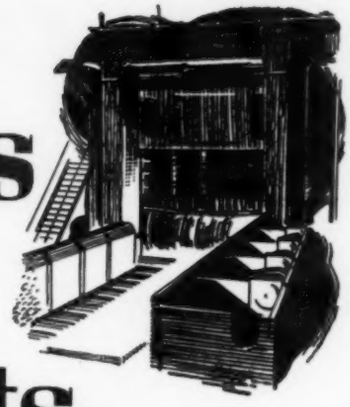


CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

5031 EAST 289th ST.
WICKLIFFE, OHIO

Crops *and* Shorts



FOR the first time in over a year, a Dun & Bradstreet quarterly survey indicates that the majority of business men expect a definite upturn. Only about 13 per cent look for decreased business in the first quarter of 1955. The survey shows the following opinions:

	Per cent expecting		
	Increase	No change	Decrease
Net sales	56	31	13
Net profits	43	45	12
Selling price	12	76	12
Inventory level	24	53	23
Number of employees.	14	79	7

▲

THERE has been a regular rash of articles in recent magazines about how to get along with the boss, how to get a raise, etc. Most of them seem to imply that all bosses are, in varying degrees, boors, but that the intelligent, diplomatic employee can handle him. We can't help but wonder what becomes of these employees when the bossing jobs open up.

▲

STEEL business is picking up faster than expected. A number of steel producers have raised their estimates of operations for the next two months. Main factor is the automobile industry, which plans to make 1,080,000 cars during November and December. This will give a total of 5,400,000 cars for 1954, the third highest year on record. What a depression!

▲

TWENTY-TWO educational institutions are cooperating with the Small Business Administration in sponsoring administrative management courses for owners and managers of small businesses, and other institutions are planning organization of similar courses.

The courses are conducted by the educational institutions, with SBA suggesting topics and providing guidance as requested. Variously termed clinics, conferences or workshops, all of the courses offer current information helpful to small business.

THE Wall Street Journal says if you think a woman can't keep a secret, try and find out what your wife got on the charge account before the bill comes in.

But they didn't say a word about wives who sidetrack the bill so that all you ever see is the overall statement a month later.

▲

THE same paper comments about secretaries:

She takes down my mumbles
In neat little pot-hooks,
And silently grumbles
With you-should-be-shot looks.

▲

IT is estimated that garages in the U.S.A. had 41,388,000 calls for road service during 1953. Tires and batteries each caused about 23 per cent of the calls.

▲

HIGHWAY construction consumes about 1,500,000 tons of steel per year, with about 46 per cent of structural steel, 42 per cent of reinforcing rod and mat, 9 per cent of culver, and the remainder in guard rails, curbings, etc. The Bureau of Public Roads estimates 42-45 tons of steel products are used for every mile of road built.

▲

A philosophical friend says that a fool and his money are usually the result of a former generation's dollars and sense.

▲

A local meeting held on October 18 in Los Angeles by the newly established Western district section of AISE had an attendance of 185. This is a fine start and speaks well for the activities of the new section.

▲

AUTOMOBILE insurance companies in the United States pay out in losses about 45 per cent of the premiums collected.

▲

TIN plate production will increase as a result of the use of cans for soft drinks. It is believed that tin containers will be used for 35-40 per cent of soft drink sales. In August, 5584 tons of steel were used in the manufacture of soft-drink cans, as against 67,903 tons for beer cans.

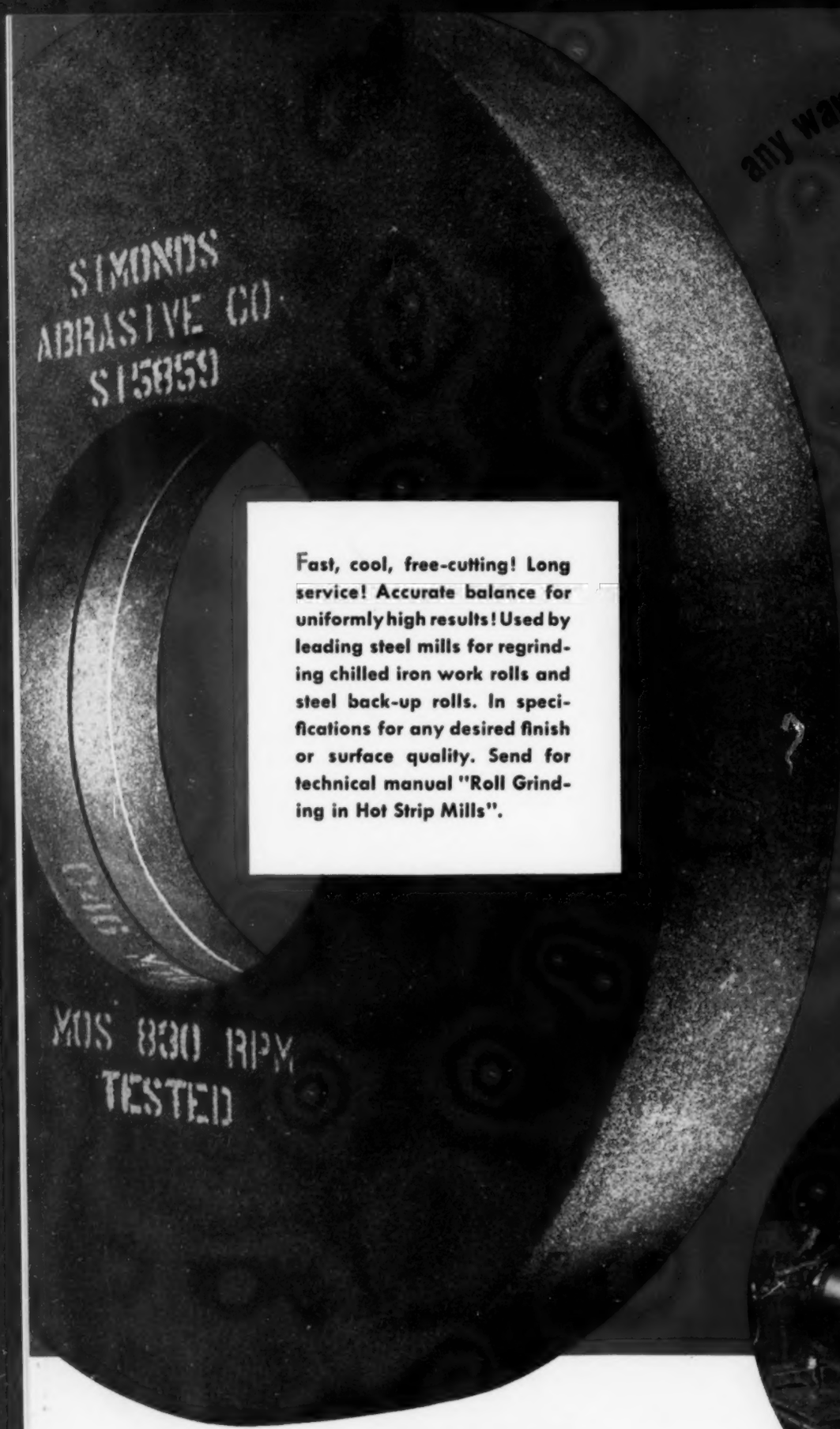
The trend is just starting. At the start of 1954, only five soft-drink canneries were in operation. By 1955, the figure is expected to hit 60 or 70.

▲

WOMEN are raising quite a fuss about the fragility of present day nylon stockings. Well, sheer today and gone tomorrow.

▲

A McGraw-Hill survey predicts that $20,700,000,000 will be spent for new plants and equipment in 1955, about 5 per cent under the 1954 figure. For the iron and steel industry, the 1955 estimate is $805,000,000, about 3 per cent under the 1954 estimate. Non-ferrous metal producers are expected to step up their spending in 1955 by 12 per cent.



any way you look at it...

SIMONDS GRINDING WHEELS are the right start for the finish you want in ROLL GRINDING

Fast, cool, free-cutting! Long service! Accurate balance for uniformly high results! Used by leading steel mills for regrinding chilled iron work rolls and steel back-up rolls. In specifications for any desired finish or surface quality. Send for technical manual "Roll Grinding in Hot Strip Mills".

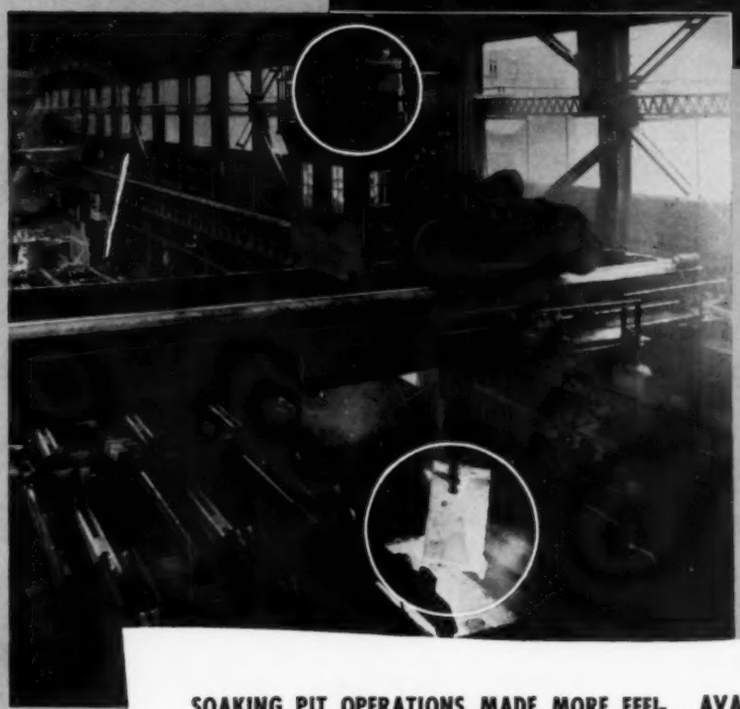
SIMONDS ABRASIVE CO.

PHILADELPHIA 37, PA.

BRANCH WAREHOUSES: BOSTON, DETROIT, CHICAGO, PORTLAND, SAN FRANCISCO • DISTRIBUTORS IN PRINCIPAL CITIES

DIVISION OF SIMONDS SAW AND STEEL CO., FITCHBURG, MASS. • OTHER SIMONDS COMPANIES: SIMONDS STEEL MILLS, LOCKPORT, N.Y., SIMONDS CANADA SAW CO., LTD., MONTREAL, QUEBEC AND SIMONDS CANADA ABRASIVE CO., LTD., ARVIDA, QUEBEC

J&L STEEL uses DRAVO crane cab coolers in its hottest spot



SOAKING PIT OPERATIONS MADE MORE EFFICIENT, WORKING CONDITIONS BETTER . . . The hottest spot in any steel mill crane operation is over the soaking pit. Temperatures range as high as 170° F.; dirt, dust, fumes and gases limit the time any man can work his crane over this installation.

Jones & Laughlin Steel Corporation has eliminated this working hazard by installing Dravo Crane Cab Coolers on the cranes working over these hot spots.

CRANE CAB COOLERS HAVE LONG SERVICE LIFE, PROVIDE YEAR-'ROUND AIR CONDITIONING . . . Dravo Crane Cab Coolers are ruggedly constructed, factory assembled and pre-tested to provide years of more-than-satisfactory service. All equipment in the unit is readily accessible with ample space for quick and efficient maintenance.

In the various air conditioning functions the crane cab cooler not only filters the air, removes dust, dirt and fumes, but heats the cab in winter, cools it in summer and provides constant ventilation the year around.

AVAILABLE IN SINGLE UNIT OR IN SPLIT-TYPE UNIT; IMMEDIATE DELIVERY . . . Dravo Crane Cab Coolers are built in two models—the self-contained unit, mounted on any available space on the crane; and the new split-type unit where the condenser section is mounted on the crane and the conditioning section in the cab.

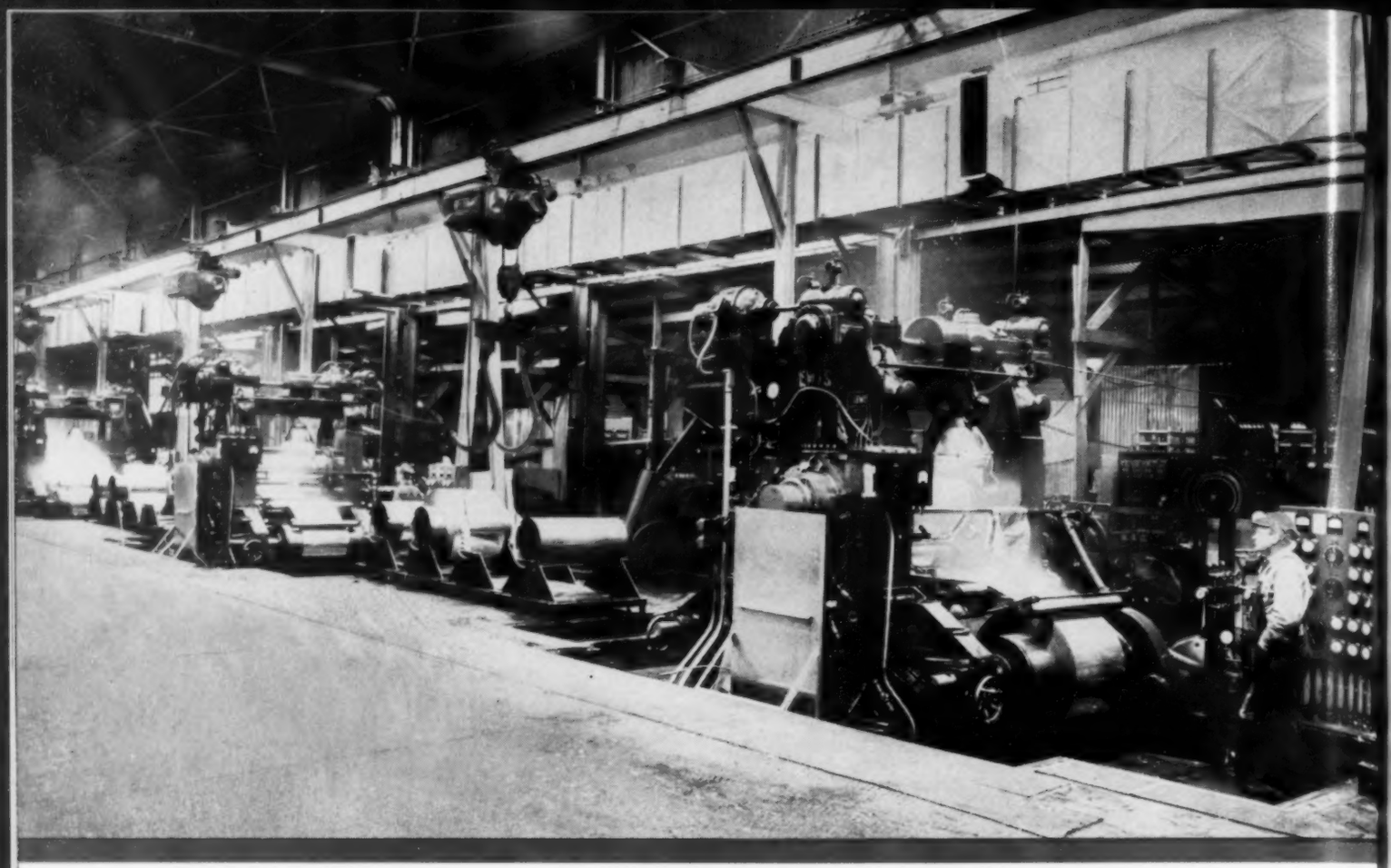
The Dravo Crane Cab Cooler can be easily and quickly installed on any type of crane with a minimum of down-time required. Units are available now! Write to Dravo for more information—or phone the nearest Dravo office and have our representative call on you.

DRAVO

DRAVO CORPORATION

Fifth and Liberty Avenues, Pittsburgh 22, Pa.

Sales Representatives in Principal Cities



. . . will roll foil from .00035″ at speeds up to 4000 fpm

depending upon gauge thickness

To roll out thin sheets of aluminum at speeds up to 4000 feet per minute has taxed the ingenuity of the finest rolling mill engineers. But there are now over one hundred modern Lewis Foil Mills in operation, such as the 9″ and 21″ x 44″ units shown in the illustration.

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In fact, if you have any problem involving rolling mill machinery, our experienced engineers and modern manufacturing facilities are always available.

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Iron AND Steel ENGINEER

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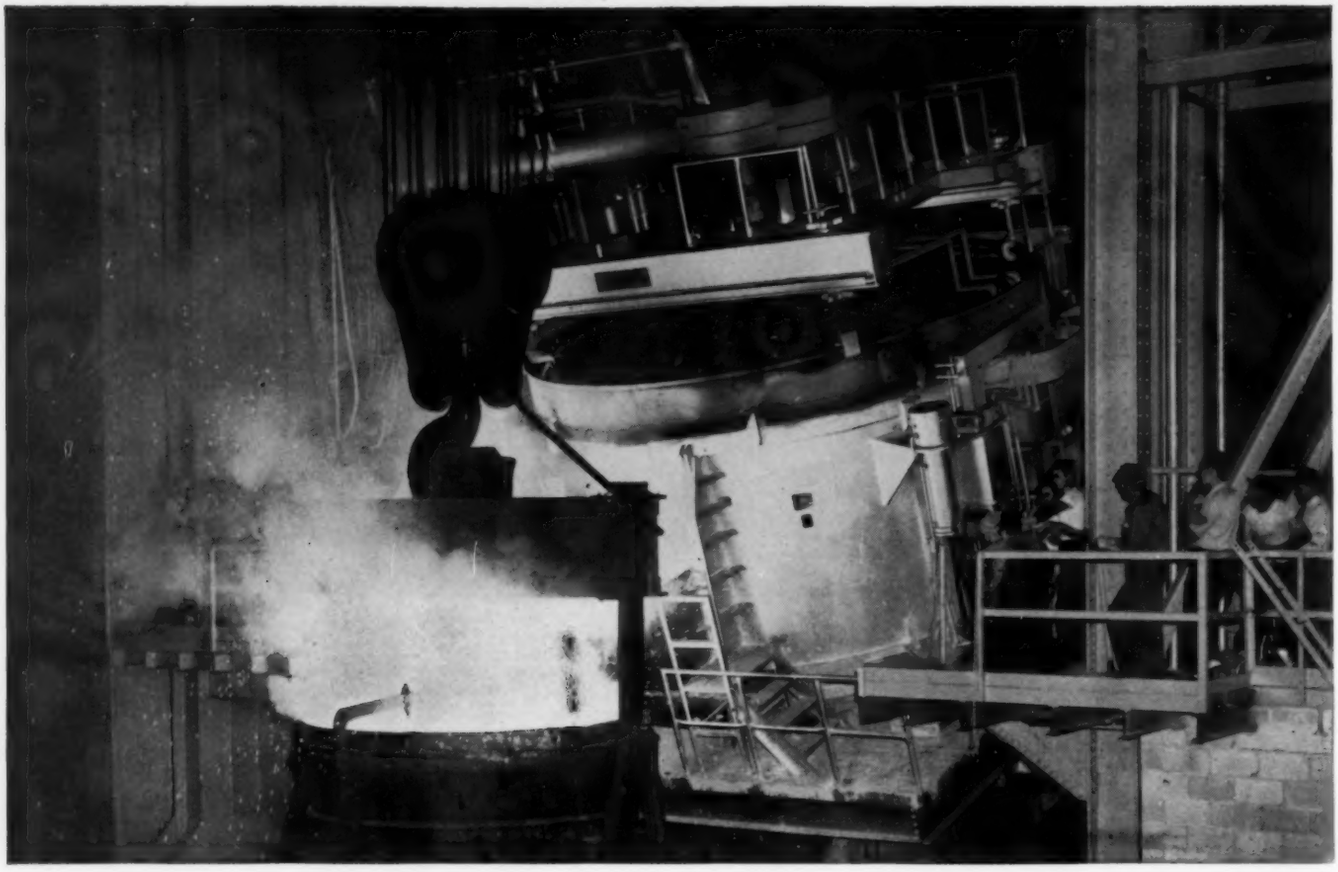


Atlantic Steel's 75-ton baby *breaks records for 2nd birthday*

On May 13th Atlantic Steel Company in Atlanta celebrated the 2nd birthday of their 75-ton Lectromelt* Furnace. Look at how they have increased its production with experience . . .

RECORD HEATS . . . . Feb. 15, 1953—84 tons for 41 ingots
Feb. 8, 1954—88.15 tons for 43 ingots

DAILY RECORD . . . . March 7, 1953—460.3 tons
Nov. 5, 1953—473 tons

WEEKLY RECORD . . April 19-25, 1953—16 tons/hour for 35 heats averaging 76.7 tons/heat and totaling 2,684 tons

Nov. 1-7, 1953—16½ tons/hour for 39 heats averaging 77.7 tons/heat and totaling 3,031 tons

MONTHLY RECORD . . March 1953—10,890 tons
March 1954—11,894 tons

According to Atlantic they are constantly obtaining more consistent, higher quality, and are planning to let the Lectromelt carry their major production load, firing up their open hearths only as required.

Write for Bulletin #9 describing Lectromelt melting furnaces and components. Pittsburgh Lectromelt Furnace Corporation, 310 32nd Street, Pittsburgh 30, Pennsylvania.

Manufactured in . . . GERMANY: Friedrich Kocks GMBH, Dusseldorf . . . ENGLAND: Birlec, Ltd., Birmingham . . . FRANCE: Stein et Roubaix, Paris . . . BELGIUM: S. A. Belge Stein et Roubaix, Bressoux-Liege . . . SPAIN: General Electrica Espanola, Bilbao . . . ITALY: Forni Stein, Genoa. JAPAN: Daido Steel Co., Ltd., Nagoya

*REG. T. M. U. S. PAT. OFF

MOORE RAPID

WHEN YOU MELT... *Lectromelt*

Uses of Resistance Wire Type STRAIN GAGES in Steel Plants

By W. A. BLACK
Chief Electrical Engineer
Steel and Tubes Div.
Republic Steel Corp.
Cleveland, Ohio

. . . . the resistance gage provides a versatile tool in analyzing many steel mill problems . . . .

▲ MANY of the millions of dollars spent each year by the steel industry are actually wasted because certain guesses made by engineers are incorrect. Many expenditures are, in the final analysis, based almost entirely upon dimensions, weights or other figures whose correct values have not been, and cannot be, accurately determined. The engineer must, in such cases, make the best estimate he can within the limits of the theory and instruments at his disposal. The fact that his estimates are occasionally wrong by as much as several hundred per cent is not necessarily a reflection on the engineer. The magnificent and efficient steel mills operating throughout this country today stand as a glowing permanent tribute to the amazing accuracy of hundreds of thousands of those guesses and estimates. Progress in the development of these and other major technological operations can, however, be attributed largely to the fact that science and experience have been slowly but steadily battering down the walls of ignorance by getting more genuine facts, more reliable measured information for engineers and other technical people to use. This accumulation of knowledge has been a major factor in technological progress. It has been the foundation on which all modern engineering advancement has been based. The more variables that can be measured exactly, the more efficiently and more dependably a machine or piece of equipment can be designed. The progress in direct and correct measurement of physical variables is the keystone in the arch supporting today's high standard of living.

One of the fact-finding tools that has been getting more and more recognition in steel mill engineering circles is the resistance type strain gage. It consists of a little piece of fine wire used on the surface of a machine part or structure for the purpose of measuring the deformation of that surface. The assembly of wire and paper or fabric is cemented to the surface to be studied. In the diagram of Figure 1 is seen a typical arrangement of the components.

As indicated by its name the strain gage is used to measure strain, and from the strain data much other information can and has been derived. It is probable that in estimating strain, engineers have to use a larger safety factor, or factor of ignorance—whichever one prefers to call it—than in any other broad area of investigation depending upon variable functions. For instance, any engineer entrusted with the responsibility of adding to the capacity of an existing crane handling molten steel must assign arbitrary or estimated figures to loads, load distribution, strains, stresses, etc., in order to decide on his course of action. Because of the extremely hazardous character of the operation, it is necessary for him to use a large safety factor. By this means, any error in his original assumption is compounded. If, however, he wants to displace some of those assumptions with measured facts, the strain gage provides him with a means of doing so.

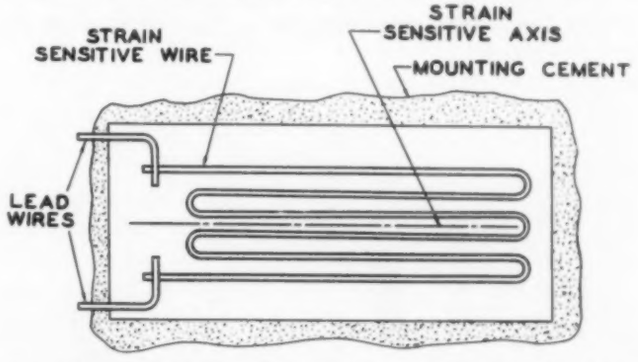


Figure 1 — Sketch shows details of construction of bonded resistance wire type strain gage.

Facts on torque in shafts, momentary pressure surges in pipe lines, weight distributions, pressure in pumps, overload in presses and many other variables can also be obtained by the use of this device. With these facts, engineers can reduce the dependence upon guess work, make expenditures correspond more closely to the actual need, and also reduce the hazard that is the associate of guesswork in design.

The resistance wire strain gage has been gaining steadily in extent and variety of use since its invention about fifteen years ago. It has been used so extensively and so successfully in the aircraft industry that it can safely be said that without it aircraft performance and aircraft safety would be far below their high present day level. Its operation depends upon the simple fact that when a wire is stretched or compressed, its elec-

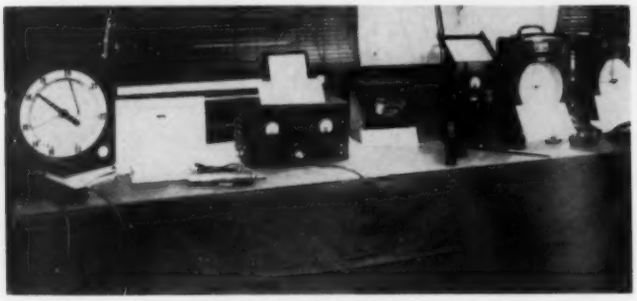
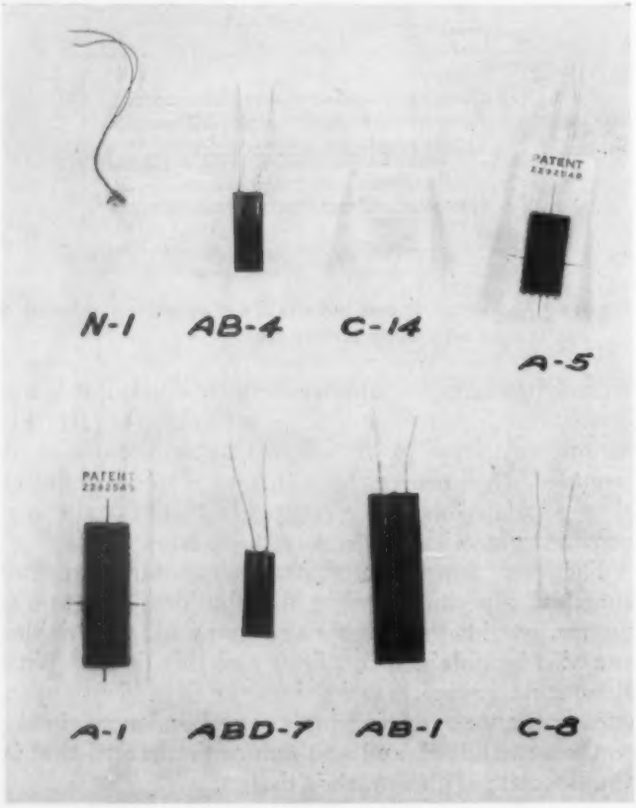


Figure 2 — Some of the auxiliary instruments needed for the strain gage are shown here. The standard box, shown third from right is a modified Wheatstone Bridge which can read strains to the millionth of an inch.

trical resistance changes. If the wire is glued to a relatively heavy mass or object, compression at the surface to which the wire is glued results in compression of the wire. Likewise, stretch of the object results in stretch in the wire. Resistance changes in the wire are used as a measure of the distortion and consequently of the forces acting on the object.

The simplest electrical circuit for measuring the change in resistance is a Wheatstone Bridge. The ramifications of that circuit are almost innumerable. The

Figure 3 — Strain gages come in a large variety of types and sizes.



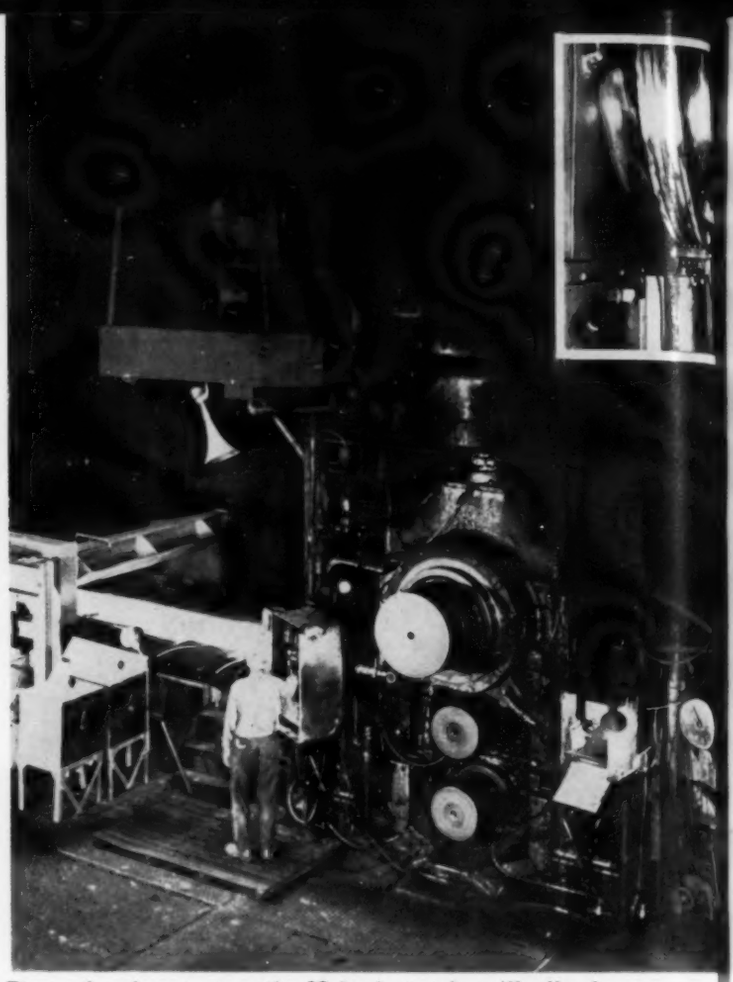


Figure 4 — In a test on the 98-in. hot strip mill, slip rings were used to conduct the current from the strain gages to the indicating box.

complexities of the electrical equipment depend upon the nature and requirements of the application. Figure 2 illustrates just a few of the instruments that can be and have been used as accessories to the strain gage.

The strain gage itself, also is available in a large variety of forms. Various lengths, widths, shapes, mountings and materials are combined to meet an enormous variety of demands. A few of them can be seen in Figure 3.

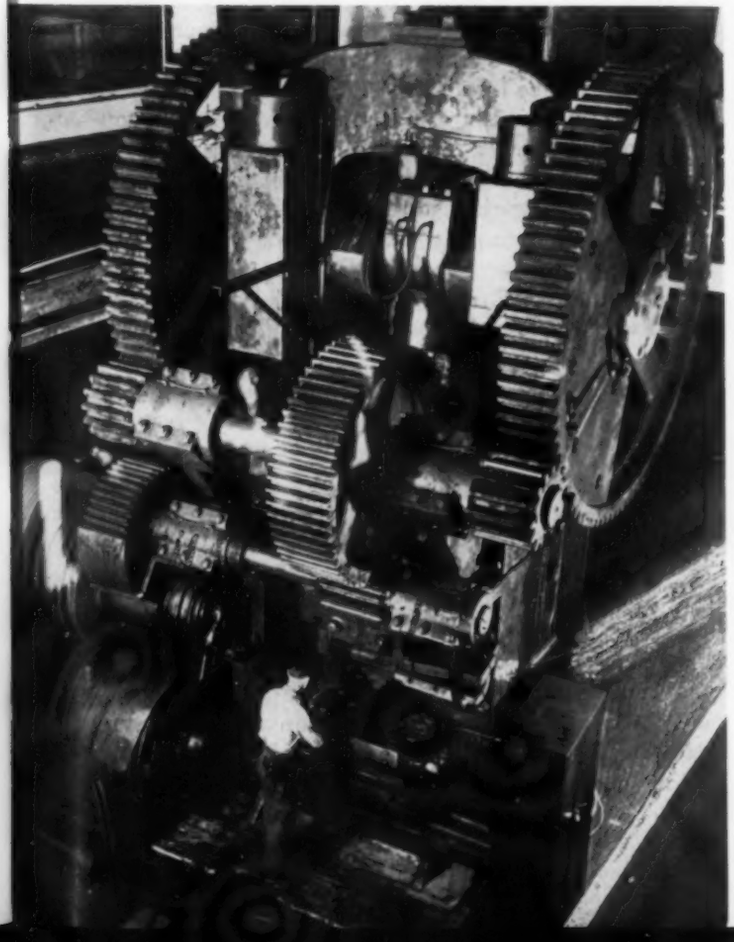
The aircraft industry was the first to make serious use of these gages. Hundreds of them were, and presumably still are, mounted on a single plane under test. Oscillographic records obtained under flight conditions provided the aeronautical engineers actual facts that could not have been even approximated by calculation. In those cases in which performance statistics could have been calculated, the mere act of calculation would have consumed a tremendous amount of costly engineering time, a commodity that always has been and probably always will be entirely too valuable to waste.

As the usage of resistance type strain gages expanded into the steel industry, it was found that the forces were larger and the fields of application were somewhat less glamorous than in a trim newly-designed airplane. On the other hand, the chances for financial return, the opportunities for economizing on design and construction, the possibilities of overload protection and the promotion of preventive maintenance—in all of these fields, the steel industry offered an extremely broad opportunity to demonstrate the worth of the strain gage.

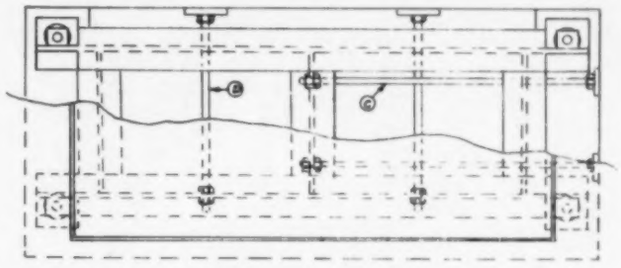
For instance, in the Cleveland 98-in. hot strip mill of Republic Steel Corp., failures had occurred repeatedly in roll necks of the No. 1 breakdown pass, similar to the roll stand illustrated in Figure 4. When it was suspected that the calculated values of spindle torque were unreliable, due to the impossibility of accurately measuring or estimating the dependent variables, it was decided that strain gages could be used to measure it. To measure the torque, strain gages were glued to the shaft and their electrical output brought out through slip rings. The slip rings are illustrated in the inset of Figure 4. Actual measurements obtained in this way revealed that momentary torque loads were in excess of 68,000,000 lb-in. The calculated values were far below this figure.

Information yielded by the strain gages led to a change in shaft design, thereby definitely averting additional shaft failures. A shear pin safety coupling was designed to break before the more expensive parts of the mill were overloaded. It was proved that the reason for roll neck breakage was that the mill was rolling far in excess of its design tonnage. In doing this, the mill was crowded to its upper limit while the temperature of the steel being rolled approached the lower limit. Also involved were operators' errors in the use of the mill, such as incorrect setting of the rolls or too high a reduction, failure to notice cold slabs or cold spots in the slabs, and failure to turn on water cooling for the rolls. The strain gage study not only provided torque data, but also focussed attention on operating errors. Such information would have been almost impossible to obtain by any other method.

Figure 5 — The loads on this 1500-ton blanking press were measured with these strain gages.



Another use of the strain gage had to do with an oil company's complaints of line pipe failures. Since examination of the failures did not reveal any steel defects that could have accounted for the breakage in the pipe, the oil company agreed to let the pipe manufacturer mount strain gages on the pipe line where the failures had occurred. The oscillographic record revealed that,



A ELECTRICAL CELL (4)
B PUSH ROD (4)
C LONG. CHECK RODS (2)
D SHORT CHECK RODS (2)

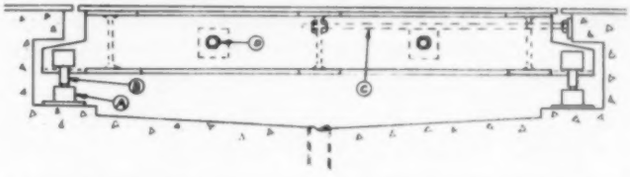


Figure 6 — Sketch shows application of electric strain gages.

contrary to previous assumptions, pressure in the line was not kept below the safe operating pressure of the pipe, but was subject to frequent surges far beyond the safe operating limit.

Another type of valuable service rendered by the

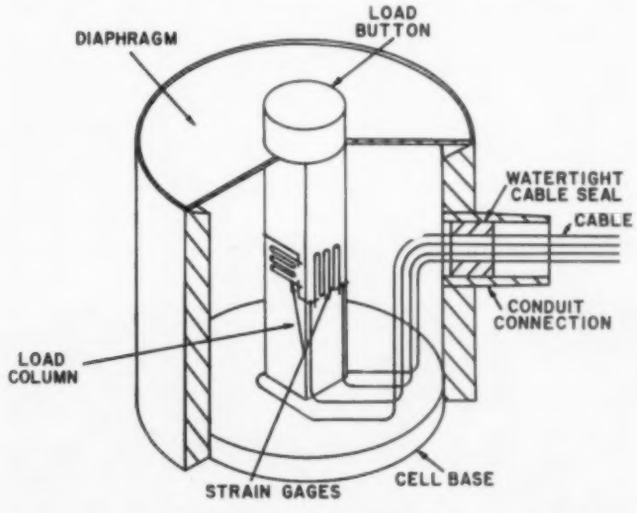


Figure 7 — Strain gages can be mounted on what are commonly called load cells for measuring loads.

strain gage is exemplified in load measurements on a fifteen hundred ton blanking press. Its magnitude is apparent in Figure 5. See markings on picture. Shaft breakage had been attributed by the operator to defective shafts. Since no evidence of the defects could be

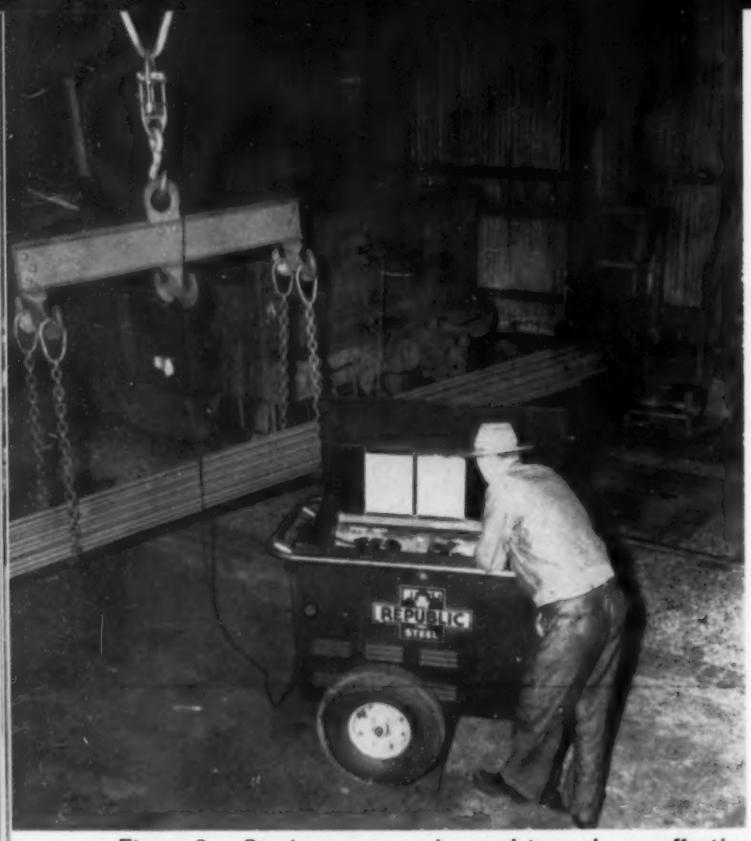


Figure 8 — Strain gages can be used to make an effective crane scale which weighs the load as it is lifted.

found, it was decided to use strain gages to measure the actual load. Measurements revealed that the operating load was so small a percentage of the shaft capacity, that even if the shaft happened to have major defects in it, it would not break in the kind of service it was performing. The results, in this case, provided convincing circumstantial evidence that the operator had been overloading the press in some way.

An interesting branch of the strain gage work which may have important repercussions throughout the entire steel industry is the use in weighing. They have been used in several different ways to solve weighing problems that could not be readily solved by conventional weighing devices. Because of the flexibility in electrical circuits, they offer promise of automatic control such as could never be obtained by any other method of weighing.

To the steel mill engineers making the early applications of strain gages, it became apparent as far back as 1944 that an element responding so accurately to load changes offered possibilities in weighing. Extensive work to promote this application has been done.

A diagrammatic representation of a simple electric or strain gage platform scale can be seen in Figure 6. Circular cells at each of the four corners of the platform contain accurately machined columns to which have been glued strain gages. A diagram of such a cell is shown in Figure 7. Pressure on the platform is transmitted to the columns in the cells. Electrical outputs of the four cells are added together and identified on a single indicator or printer.

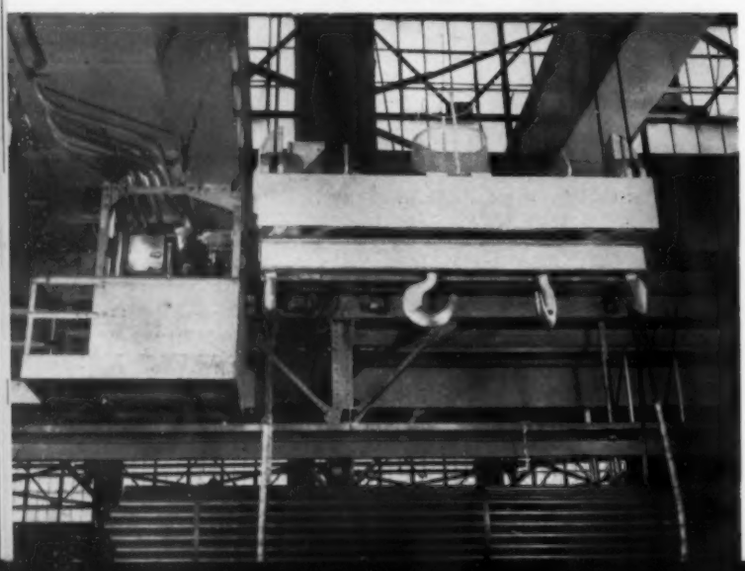
The first electrical platform scale in the steel industry was used to weigh coils of strip as they roll across the platform from a tandem mill. The capacity is forty thousand pounds.

Figure 8 is believed to be the first portable 50,000-lb crane scale used in the steel industry. The basic equipment was originally developed for load distribution studies in aircraft, but housing the instrument, a battery and other accessories in a cart, provided steel plants with a 50,000-lb scale that could be used wherever a crane was available to pick up the load to be weighed.

The crane operator in Figure 9 is reading the weight of the load of tube suspended from the crane. The scale used is believed to be the first built-in electrical crane scale in the industry with high accuracy, multiple cells, and a spreader beam especially designed to accommodate electric weighing equipment without any loss of head room.

The odd basket-like structure in Figure 10 is used for weighing hot ingots put there by the soaking pit crane. Weight records are obtained on a recorder on the opposite side of the soaking pits. The scale platform is maintained in the weighing position at all times. While it is the intention of the crane operator to lower the ingots into the basket gently, it is not always possible to gage the distance from the ingot to the basket accurately. The result is that the ingots are frequently dropped onto the scale platform from an appreciable height. A 10-ton ingot does not need much height for the development of a terriffic impact, sufficient to demolish in short order a conventional weighing system. This scale has been in service since October, 1951, in spite of the punishment inflicted by falling ingots.

Figure 9 — Crane scales can be so set up that the weight is indicated in the operator's cab.



Several electric scales have been built for weighing molten steel at various points in its travels through the plants. The transfer car scale in Figure 11 is a typical example. Most of these scales are stationary but this one has the weighing cells mounted on a car with their output conveyed to the dial indicator and printer through a cable reel. While these scales weigh only 40,000 to 60,000 pounds of steel, cell capacities in all cases are 400,000 pounds. The difference allows for platform, ladle and other tare weight along with a safety factor of about three.

Except for the hot metal scales referred to in the paragraph above, Republic has concentrated on weighing applications which could not be conveniently or satisfactorily handled by conventional scales.

The success and relative cost of these installations

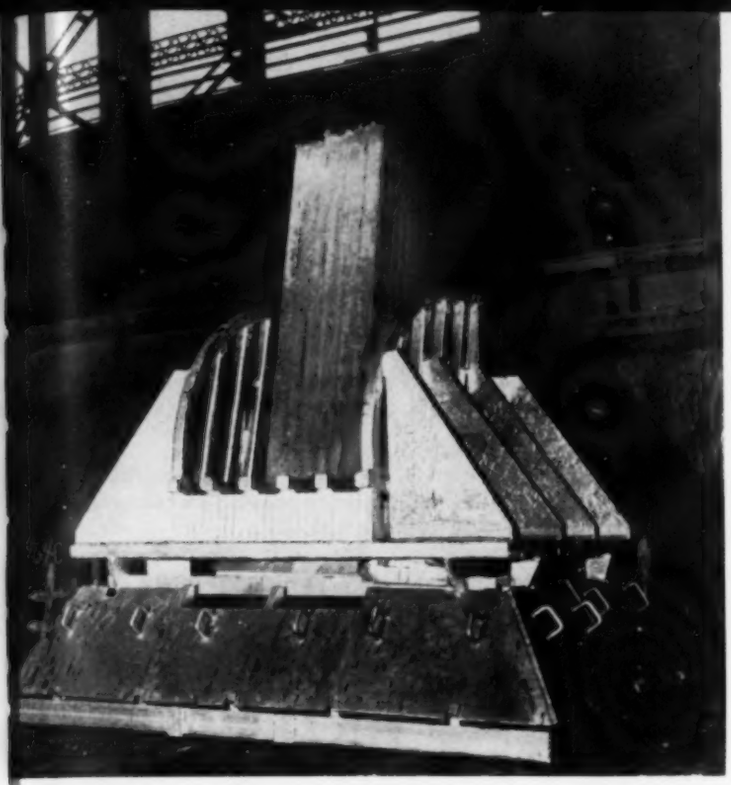


Figure 10 — Weighing of hot ingots involves difficulties in the impact which occurs when the ingot is lowered into the basket.

along with other experiences throughout the industry are an indication that in the near future, strain gage scales will offer lever type scales significant competition in several fields.

One of the most interesting of recent strain gage applications in Republic Steel Corp. was their use in studying the operation of a 44-in. blooming mill at the Cleveland plant. Here was one of those instances in which assumptions made in the absence of actual measurement had resulted in production losses and high maintenance cost. Frequent component failures made it necessary to explore the causes and select a remedy. One popular explanation for the frequent failures was that the roller tried to roll ingots that were not as hot as they should be. While this is admittedly a logical explanation and could easily have been the cause of the failures, strain gage measurements revealed that it was by no means the complete explanation.

Because of repeated breakages of the shaft connecting the 25,000-hp steam engine to the mill, torque on that shaft was an important variable. It was also elusive. Torque depends upon several elements including roll pressure, coefficient of friction at various points, compression area in the ingot during rolling and bearing conditions. To calculate and anticipate actual torque values during rolling would be an engineer's nightmare.

Strain gages offered a means of direct measurement. It must be understood that a project involving massive equipment such as a blooming mill requires careful planning. Such details as the exact location of the strain gages, the design and construction of the slip rings, the accumulation of associated data, the coordination of observations and above all the analysis and interpretation of the data must all be carefully planned and executed.

This is necessary in order to guarantee that the information obtained will be dependable and useful. These factors plus the severe mill vibration and the presence of water, grease and scale in voluminous quantities resulted in a complicated project extending over a period of several months. The final determinations yielded facts which are expected to be a major factor in reducing the high maintenance cost and operating losses of this mill. The variables measured were:

1. Torque of both top and bottom spindles.
2. Mill housing load.
3. Pass height.
4. Reduction per pass.
5. Roll speed.
6. Ingot temperature.

Also recorded were:

1. Heat numbers.
2. Analysis.
3. Ingot size.
4. Slab size.
5. Rolling crew.
6. Deviation from standard rolling practice.

Instruments were located in the engine room. Phone communication between the observers on the mill and those at the instrument panel enabled them to establish the proper relationship between load variations and mill condition.

The strain gages and slip rings can be seen on the shaft in Figure 12. Figure 13 is a photograph of the painted and waterproofed assembly ready for its pro-

Figure 11 — Hot metal transfer car has load cells mounted on the car itself.

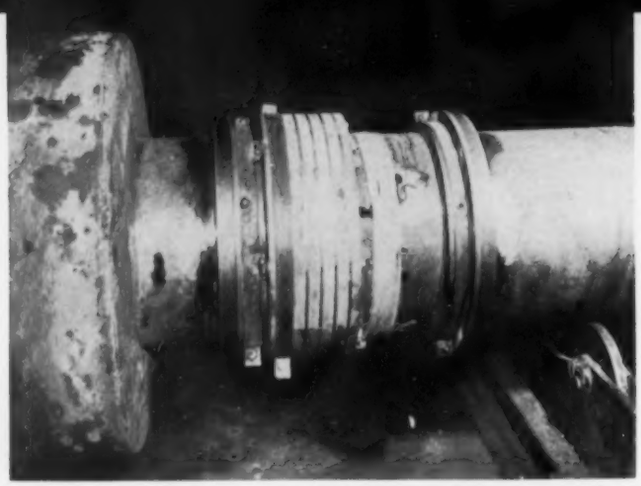


Figure 12 — Strain gages and slip rings are shown mounted on a blooming mill spindle shaft.

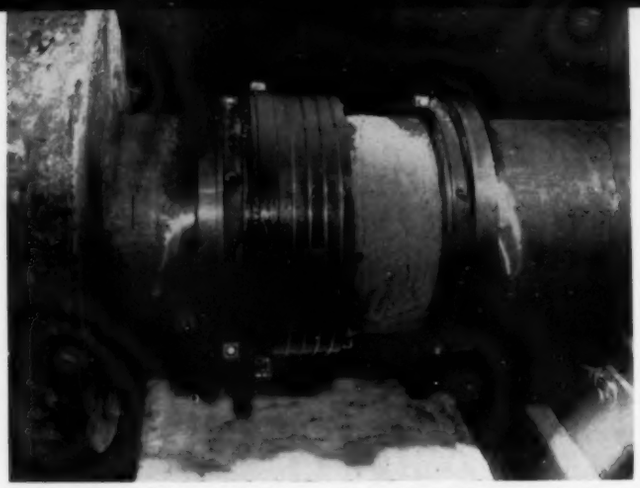


Figure 13 — After mounting, gages are painted and waterproofed (as shown in illustration).

tective cover. A cover was mounted on the shaft which had to be ruggedly built and vibration and moisture proof. The variety of measurements necessitated a variety of instruments. As already mentioned, they were located in the engine room safe from the dirt and vibration of the mill and are illustrated in Figure 14.

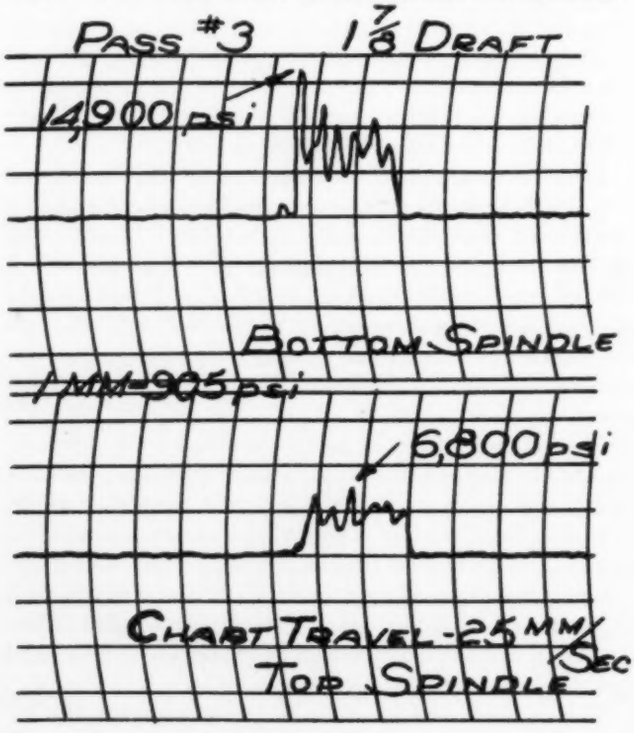
Figure 15 is a typical recording of the torque during one pass. The bottom spindle reached a peak strain of 14,900 psi while the top one reached a peak of 6800 psi. These figures correspond to torques of 20,000,000 and 9,000,000 lb-in. in bottom and top spindles respectively.

Conclusions derived from the data collected are:

1. Twenty per cent of the peak loads exceeded the endurance limit of the shaft. The diagram of Figure 16 illustrates the meaning of this point. Increases in either load or frequency decrease the endurance limit of a member. In this instance, 70 per cent of the peak loads were within safe limits, and 30 per cent were beyond the safe limit. This means that maintaining the peaks at the normal frequency of the mill would result in breakage of the shaft.
2. The average value of the spindle torque was well within safe operating limits. Failures were caused not by a high sustained load, but by high peak loads at a high frequency. The column on the left of Figure 17 is a diagrammatic representation of the relative torque values.
3. Both average and peak loads on the mill housing were well within safe limits. The relationship of these values is indicated in the right hand column of Figure 17. The peak reading for 20,000 ingots is so far below the capacity of the housing that the possibility of overdesign is indicated. By developing such information, strain gages not only reveal weak points in design, but also can lead to reduced expenditures for unnecessary mass.
4. Contrary to expectations, the mill housing pressure was not proportional to the torque on either spindle or the total torque on both spindles. It is easier to measure housing pressures than torque. For this reason, it was hoped that housing pressures could be used as a measure of torque. The scatter in Figure 18 reveals that any housing stress measurement could correspond to too wide a range of torque values to be useful.
5. The fact that certain operators consistently overloaded the mill more frequently than others indicated an element of skill in mill operation.
6. The figures indicated the possibility of using torque measurement as a means of not only avoiding overload, but also as an aid in keeping loads up to the capacity of the mill. If the mill could be loaded to full safe capacity in each pass, the increase in production would probably be much

Figure 14 — Instruments for the 44-in. blooming mill test were located in the engine room.

Figure 15 — Chart shows torque measured on spindles.



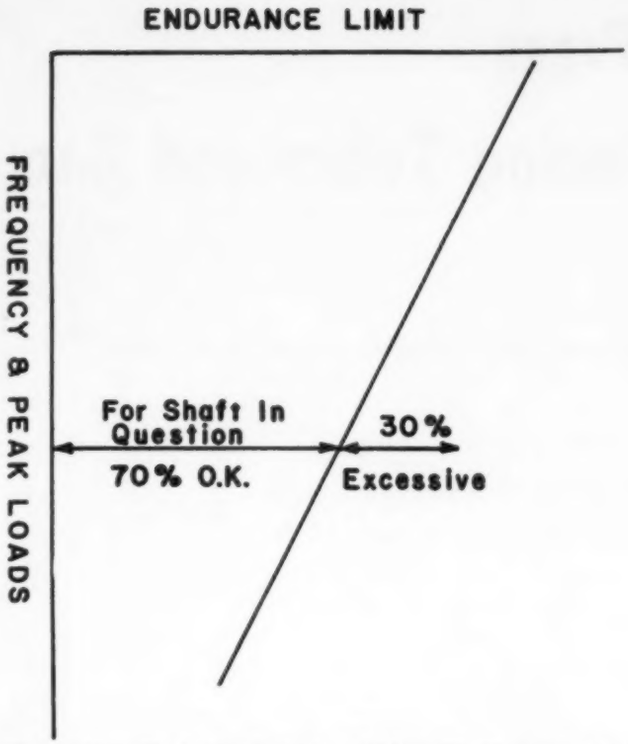


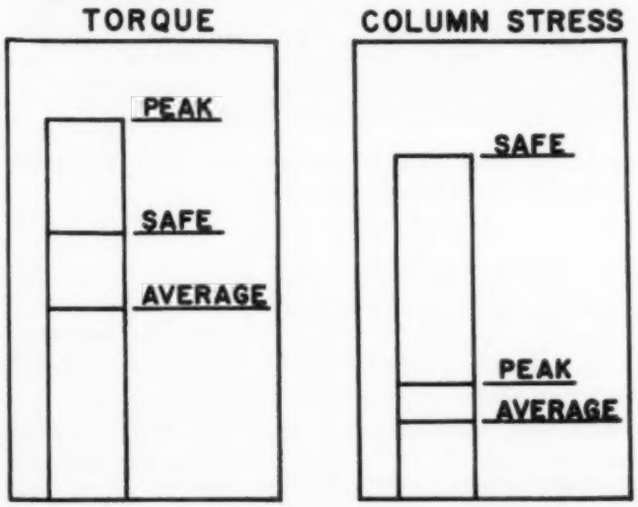
Figure 16 — Test shows that on this mill, 70 per cent of the loads were within the endurance limit.

greater than that gained by the occasional heavy drafts that caused the overload peaks.

7. Even though low temperature in the ingot naturally tended to increase the loading on the mill, no direct relationship was established between temperature and high torque. Wide scatter is apparent in Figure 19. Other factors affected the torque enough so that temperature was not the dominant influence.

While there were many possibilities as far as the selection of auxiliary instrumentation is concerned, the basic instrument in all of this study, the indispensable instrument for which there is no adequate substitute, was the resistance wire strain gage. In no other way could such concise and accurate data have been obtained.

Figure 17 — Diagram shows relative torque values and column stresses.



The present tremendously high cost of operation and the keenly competitive era which we now have entered is going to place more and more of a burden on the engineer to design and build efficiently. His work must not only provide a high rate of production, but also a minimum maintenance expense with minimum investment in equipment. Because of that, it becomes extremely important for the engineer to use all available modern instrumentation to develop factual information on which he can base his designs. This same factual information can also frequently be used to lower operating costs and provide overload protection.

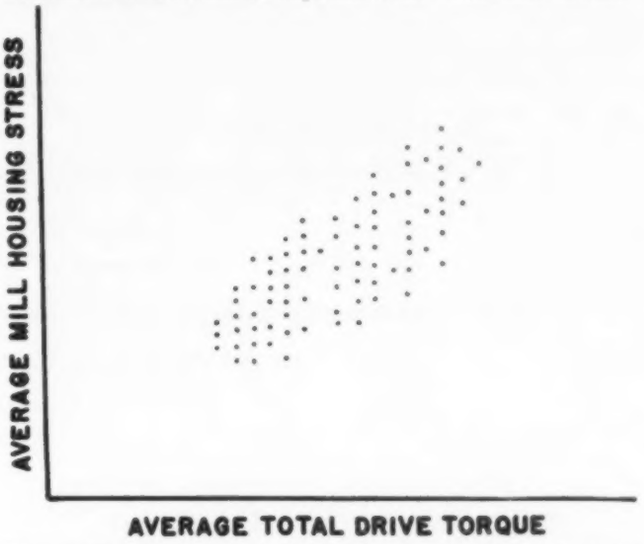


Figure 18 — Housing stress measurements did not correspond directly with torque values.

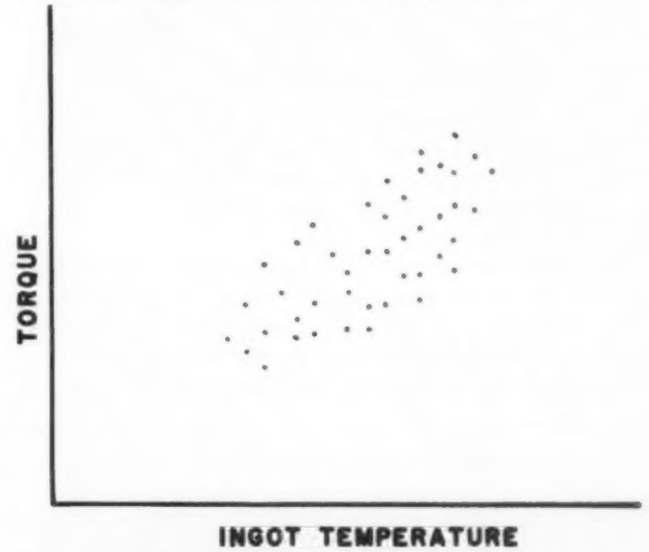


Figure 19 — There was poor correlation between torque and ingot temperatures.

Instrument development has been so rapid in the past decade that the design engineer is still a long way from taking full advantage of the possibilities of basic fact determination.

As the engineer progresses in this field, he will find the resistance wire gage particularly important. It will help to guide him through that no-man's land of torque, stress, and strain which has in the past been so short on road-signs and long on road-blocks.

A Mechanical Extrusion Press for Producing Tubes and Bars

By ASTOR L. THURMAN

Executive Vice President, Mannesmann-Meer Engineering and Construction Co., Inc., Easton, Pa.

. . . . mechanical extrusion presses can produce small diameter seamless tubing in practically all grades of steel . . . .

▲ THE mechanical extrusion press is new to American industry, and so many radically new developments have recently been presented that in its latest form, it is new to the whole world. Outstanding among these recent developments is a new 2200-ton press designed to extrude a 250-lb billet. This unit will have the same high rate of production as smaller presses now in operation, which extrude up to 180 steel tubes per hour.

This new press will provide an ideal supplement to many existing seamless mills, where it is desired to increase tonnage output by shifting present rolling mill equipment over to larger diameter tubing, and by using the press for production of the smaller sizes. By extruding a 250-lb billet, this press becomes ideal for producing all conventional pipe and tube sizes up to 2⅞-in. in 35-ft lengths; it will extrude larger diameters in shorter lengths.

The addition of this press to existing facilities also greatly broadens the possible range of products of any seamless mill, since it extrudes all conventional grades of high alloy as well as the various grades of stainless steels. Considering the high production rate of this press, the logical manner in which it provides for expanding present seamless mills, and the possibility of readily extruding the high alloy and stainless grades of steel, this new tool should find many uses in the American seamless tube industry.

Figure 1 — Billet is being charged into a 1500-ton press.

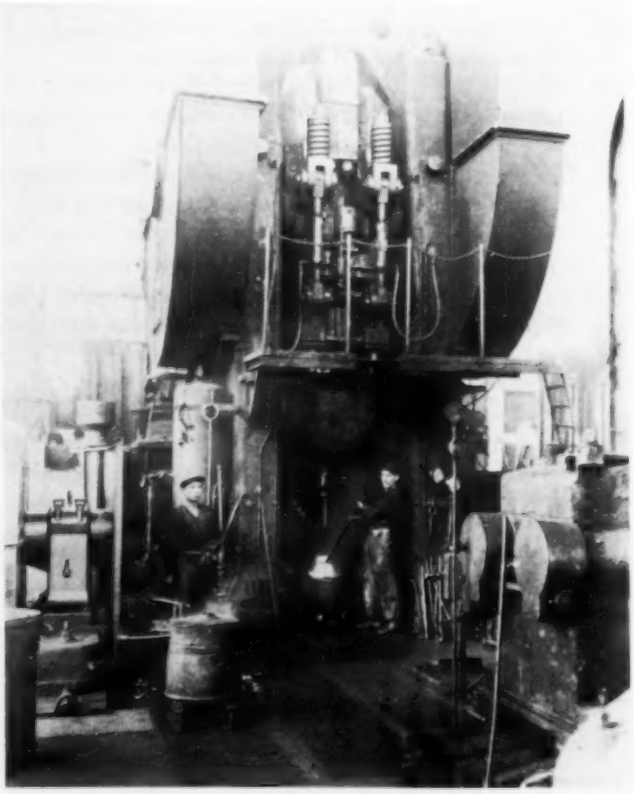


Figure 2 — After billet is released and lubricant added, press is ready for extrusion cycle.

Although this mechanical extrusion press is new to American industry, it has been economically producing steel tubing in Germany for over 25 years. The

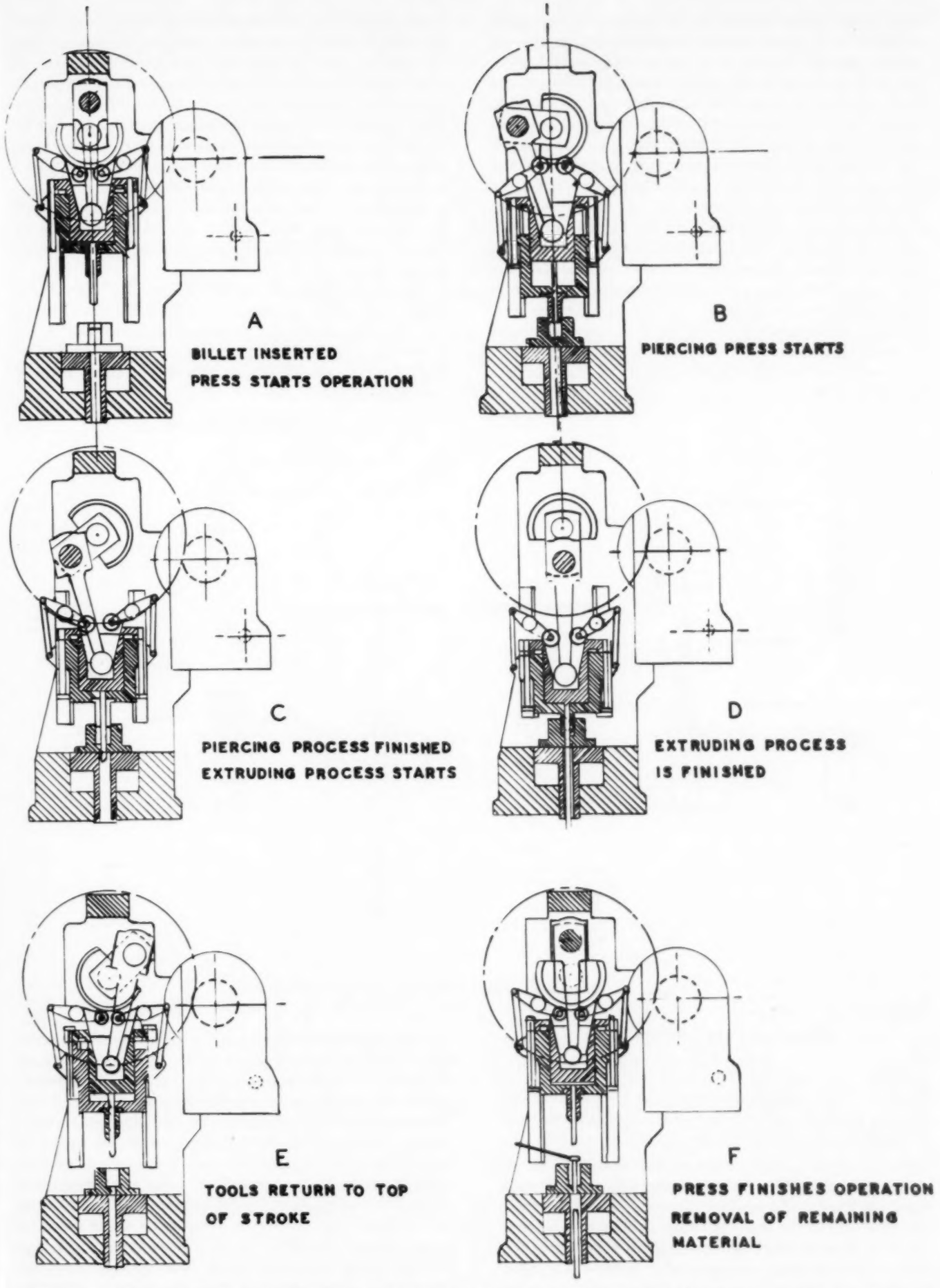


Figure 3 — The action of the press is given by the six sketches a, b, c, d, e, and f which give sequence of operations.

early patent covered the use of fusible slag and other solids, such as glass, as lubricating media for the extrusion process. As a result, experiments were carried out with glass and many other lubricants. While it has been found to be a satisfactory lubricant for steel extrusion in a slower process, where the glass is given time to melt, it was found that with glass as a lubricant, it was not possible to take full advantage of the fast operating cycle of the mechanical press. The most satisfactory lubricating media for the mechanical extrusion process when extruding ordinary carbon steels has been found to be a mixture of graphite, oil, and a separate chemical ingredient. When extruding stainless and some of the high alloy steels, changes are made in the ingredients. If for some special application it is desirable to use glass as a lubricant on the mechanical extrusion press, the frequency of extrusion of the press can readily be slowed down to obtain the full lubricating effect of the melted glass.

the mandrel is forced down to pierce the billet as shown by view C. Now the pressing head and the mandrel are brought down to their lowest position, and the extrusion is completed, as indicated by view D. After finishing the extrusion process, the tools travel back to their top position to be ready for the next cycle, as seen by views E and F. The next cycle will start immediately after removing the billet remainder, and as soon as a new billet has been placed into the receiver.

Removal of the billet remainder is performed by a special shear mandrel, which is placed into position by the operator at the end of the extruding cycle as shown in view F.

As indicated by the various views of Figure 3, the billet receiver rests upon a fluid filled chamber, which serves to some degree as a cushioning device during the extruding operation, and a safety plug is provided so that it serves principally to protect the press parts in case of overload.

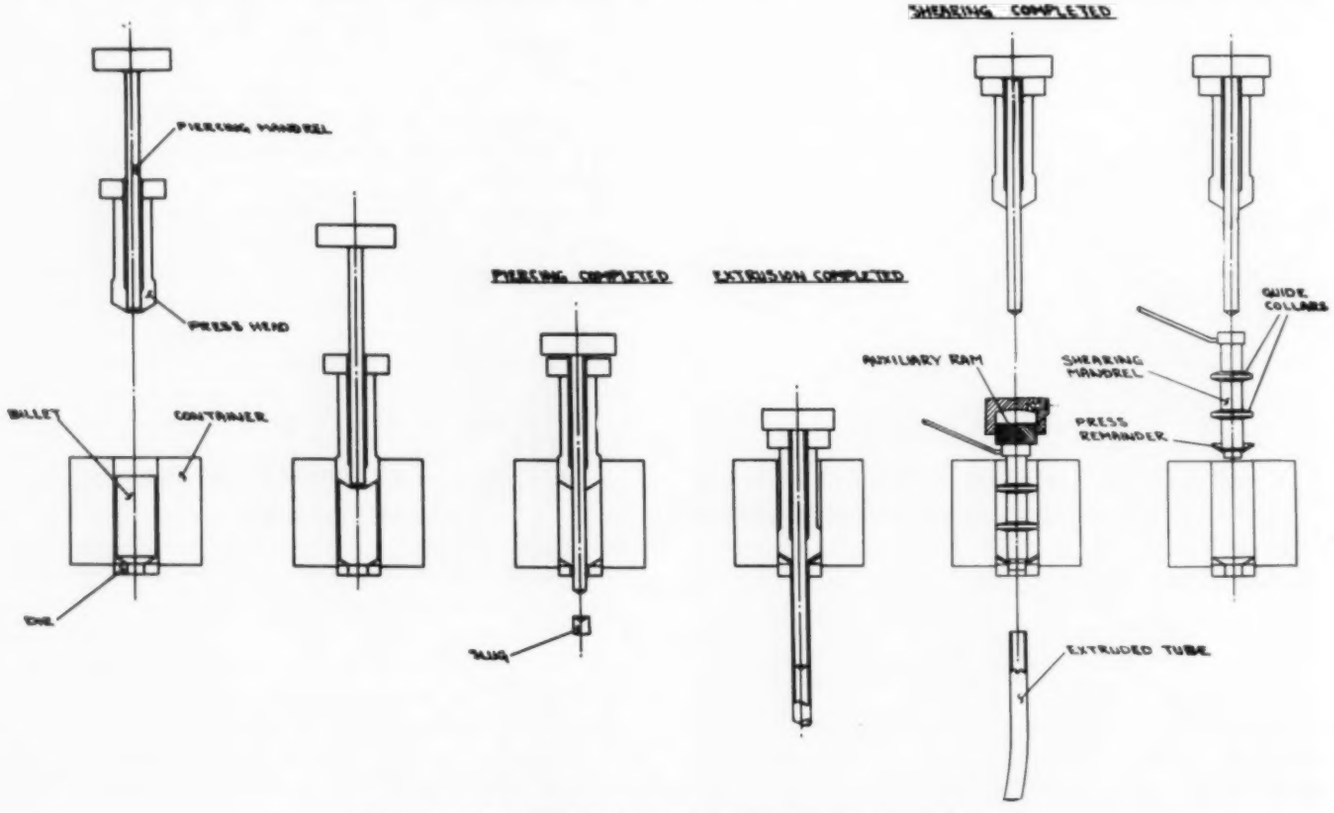


Figure 4 — Schematic shows steps in extrusion operation.

PRINCIPLE OF OPERATION

Figure 1 shows the charging of a 1500-ton press, Figure 2 shows the charger ready to release the billet into the receiver. After this is done and the lubricant is added, the press is ready for the extrusion cycle.

The principle of the extrusion process and the action of the press itself are shown by the different views of Figure 3. View A shows the press ready for the extruding cycle and in the same position as shown in Figures 1 and 2. The mandrel and press head then leave this top position, coming down together to close the billet receiver and rest on top of the billet, ready for the piercing operation, as indicated by view B. Then only

Figure 4 further illustrates the operation of the press and shows the tools in larger scale. This also shows six positions of the mandrel and pressing head at different times during the press stroke. The operation of the shear mandrel is illustrated by the fifth and sixth views. The shear mandrel is first put into position by the operator. Then a special ram, which is mounted on an auxiliary carriage and operated by a separate hydraulic system, is automatically pushed into position, as seen in the fifth view. This ram presses the shear mandrel down to shear the tube free and the auxiliary carriage is then returned automatically. The operator now removes the shear mandrel with the billet remainder. Upon shearing the tube free from the die, the tube

drops to the floor below, as indicated by the fifth view. Stripping the remainder disc from the shear mandrel is performed automatically by a separate stripper device, which is operated by the press during the extruding cycle.

The relative speeds and positions of the mandrel and pressing head are shown by Figure 5. At the beginning, the pressing head travels at a high rate of speed to catch up with the mandrel so that both rest on top of the billet at the start of the piercing operation. The pressing head remains stationary during piercing, and then it travels at the same speed as the mandrel during extrusion.

On the return stroke the pressing head remains stationary until the crank has moved about 45 degrees and then the mandrel and pressing head travel upward at the same speed until near the end of the return stroke, when again the pressing head speeds up to gain its higher top position at the same time the mandrel reaches the upper point of its stroke. These various motions are obtained by means of the cam and linkage mechanism shown by the various views of Figure 3.

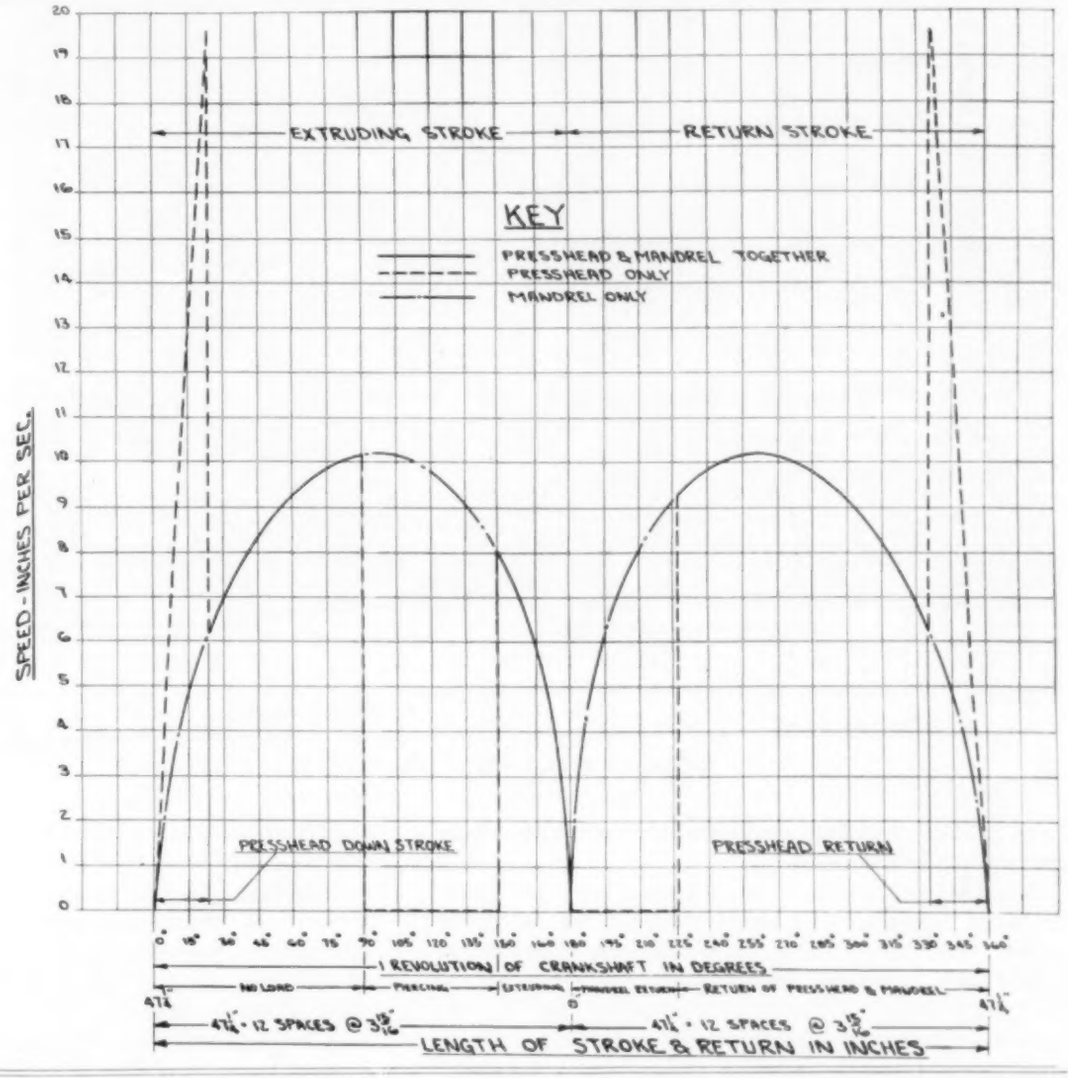


Figure 5 — Chart shows speed of press at various positions in the cycle.

PRESS DRIVE

On all presses now in operation the main drive is made up of an a-c wound rotor induction motor with a fly-wheel and a specially designed clutch-coupling and brake system. The driving motor for a 1200-ton press is rated at only 400-hp, but the flywheel is about 11-ft in diameter, has a 16-in. face and weighs about 33,000 pounds. Obviously the majority of the power for piercing and extrusion is delivered by the flywheel, as indicated by the curves on Figure 6. This diagram shows a peak power demand of about 3,000-hp at the beginning of extrusion and this is almost entirely provided by the inertia of the flywheel.

When this type of drive is used, the motor and flywheel run continuously and the crankshaft is connected by the clutch to start the extruding cycle. Since piercing and extruding require only 110 degrees of crankshaft travel, and since piercing starts at the maximum downward speed of the mandrel, the total time for the extrusion process is only about 2½ seconds. The characteristics of the press are thus ideally suited to the extrusion process; the resulting high piercing and extrusion speeds obtain the most beneficial result of short contact time between the tools and the extruded material. A conventional drive with wound rotor induction motor, flywheel, clutch and brake is shown in Figure. 7.

When a wide range of products is to be extruded, a d-c motor with a 2 to 1 speed range can be used to obtain the ideal extrusion speed. The flywheel, clutch and brake would also be used with the d-c motor in this

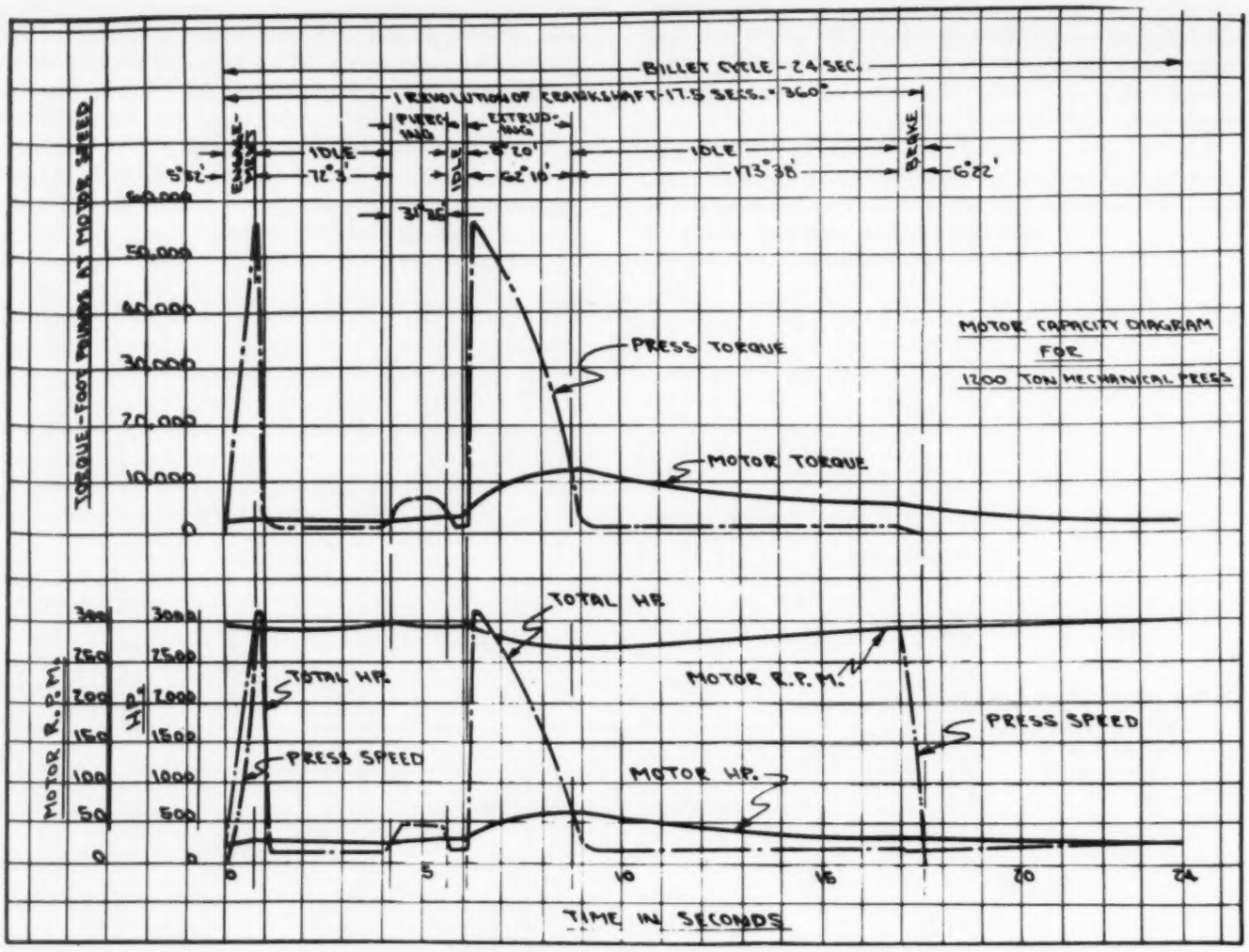


Figure 6 — Majority of power is delivered by flywheel.

case, but the operating speed would be preset to suit the material to be extruded.

As indicated above, main drives in the past have involved clutching and declutching of the crank for every cycle. Now to make it possible to obtain every conceivable operating condition for the press, an entirely new drive has recently been developed. In this case a d-c motor is coupled solidly to the press crankshaft through suitable gearing, and power to the motor is supplied by a flywheel motor-generator set; in other words, the flywheel is moved from the extrusion press drive to the motor-generator set where it can still limit peak power demand from the electrical system, with a resulting load condition for the driving motor of the motor-generator set quite similar to that of the motor power curve which was shown in Figure 6.

With this drive, it would not only be possible to select different piercing and extrusion speeds for various materials, but if desirable, it would even be feasible to provide a uniform extrusion speed, as indicated by Figure 8. As shown by the speed curve of the motor, its speed is brought to a minimum at the 90 degree crank position, where the press speed is at a maximum. From that point the normal crank motion causes a decrease in press speed, but since the motor can be made to accelerate at a rate proportional to the deceleration rate of the crank motion, a practically uniform extrusion speed can be obtained. The great flexibility of this type of drive makes such a result possible. This extreme condition may not be desirable, but this drive makes it possible to obtain any operating condition between this uniform press speed and the normal crank motion at constant motor speed. This illustration is offered to show a means whereby any practical extrusion rate may be obtained from the mechanical extrusion press. In most cases, of course, it is best to maintain constant motor speed so that full advantage may be obtained from the crank motion; that is, to provide the highest possible speed at the start of the piercing and extruding cycles.

TOOLS AND TOOL LIFE

Tools and tool life are very important factors in the operation of any extrusion press. The tools which are most exposed to heat and wear and which consequently have the shortest life are, of course, the mandrel and the die; nevertheless even the die life averages about 250 to 300 tubes per die and the mandrel life between 400 and 500 tubes per die; the pressing head lasts for about 2000 to 2500 operations. The tool holders have been designed in such a way that it is possible to make quick changes on both the die and the mandrel. Average changing time for the die is about 45 seconds and

for the mandrel 105 seconds. Due to recent improvements in tools and lubricants, very infrequent changes are now required for either the die or the mandrel. For example, dies are now changed on an average of every 50 to 60 tubes, the mandrel after about 50 even up to 150 tubes, depending upon the quality of the material. The changes are less frequent on the higher quality stainless steels as compared to the low quality basic bessemer steels.

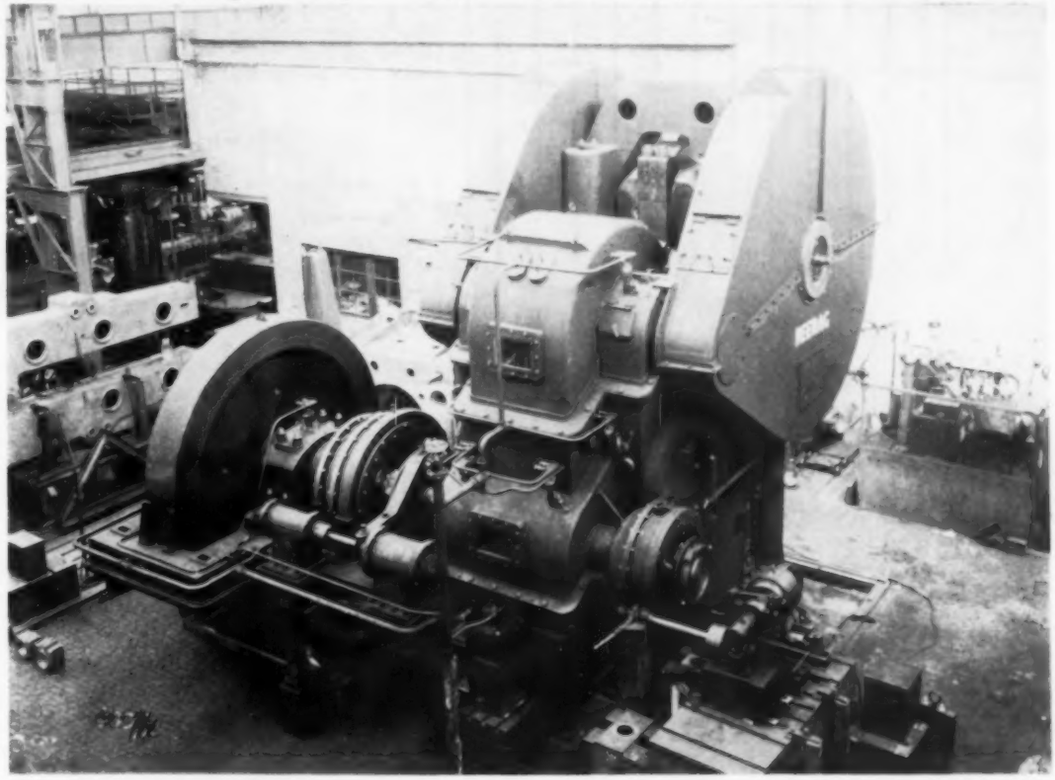


Figure 7 — Conventional drive consists of wound rotor induction motor, flywheel, clutch and brake.

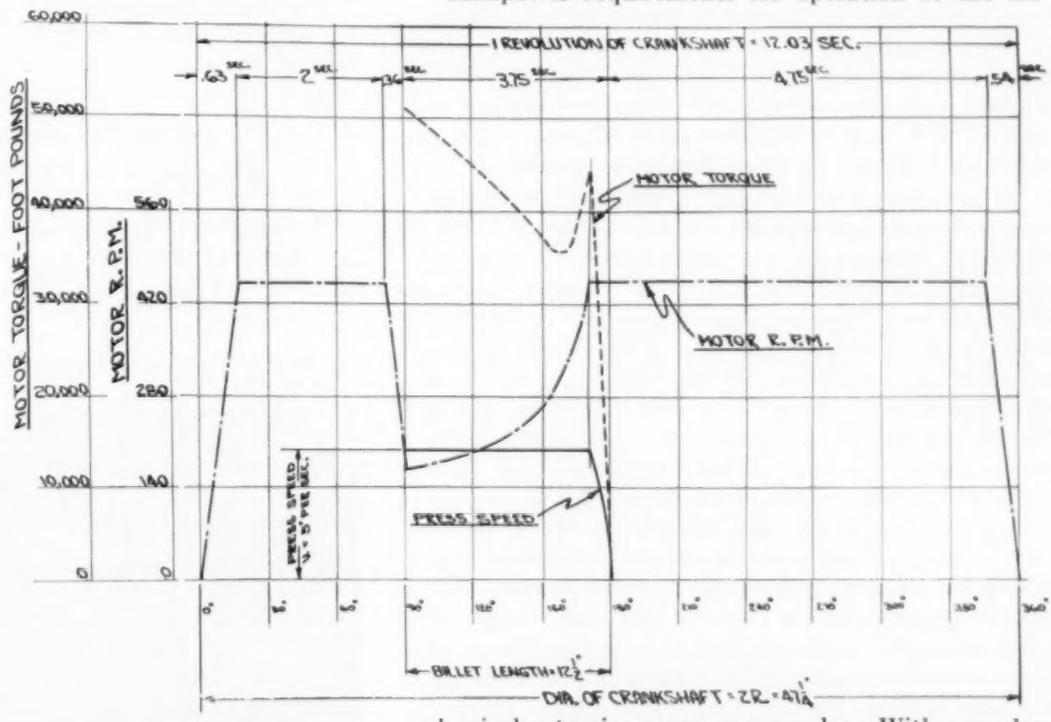


Figure 8 — It is possible to provide a uniform extrusion speed.

MECHANICAL EXTRUSION PRESS PLANT

Figure 9 shows a general layout of the hot mill for such an extrusion press plant. Principal items are the billet furnace, the descaler, the mechanical extrusion press, the reducing mill and the cooling bed. The billet heating furnace, the descaler and the press are on the second floor, or balcony; the tube is extruded down to the first floor where it is guided to the reducing mill by one of the operators. Figure 10 is a view of the reducing mill, the outlet conveyor and a portion of the cooling bed.

Manpower requirements for operation of the mechanical extrusion press are very low. With a modern furnace and suitable material handling facilities, only nine men are required for the hot mill proper, that is, two furnace men, the press operator, the press charger,

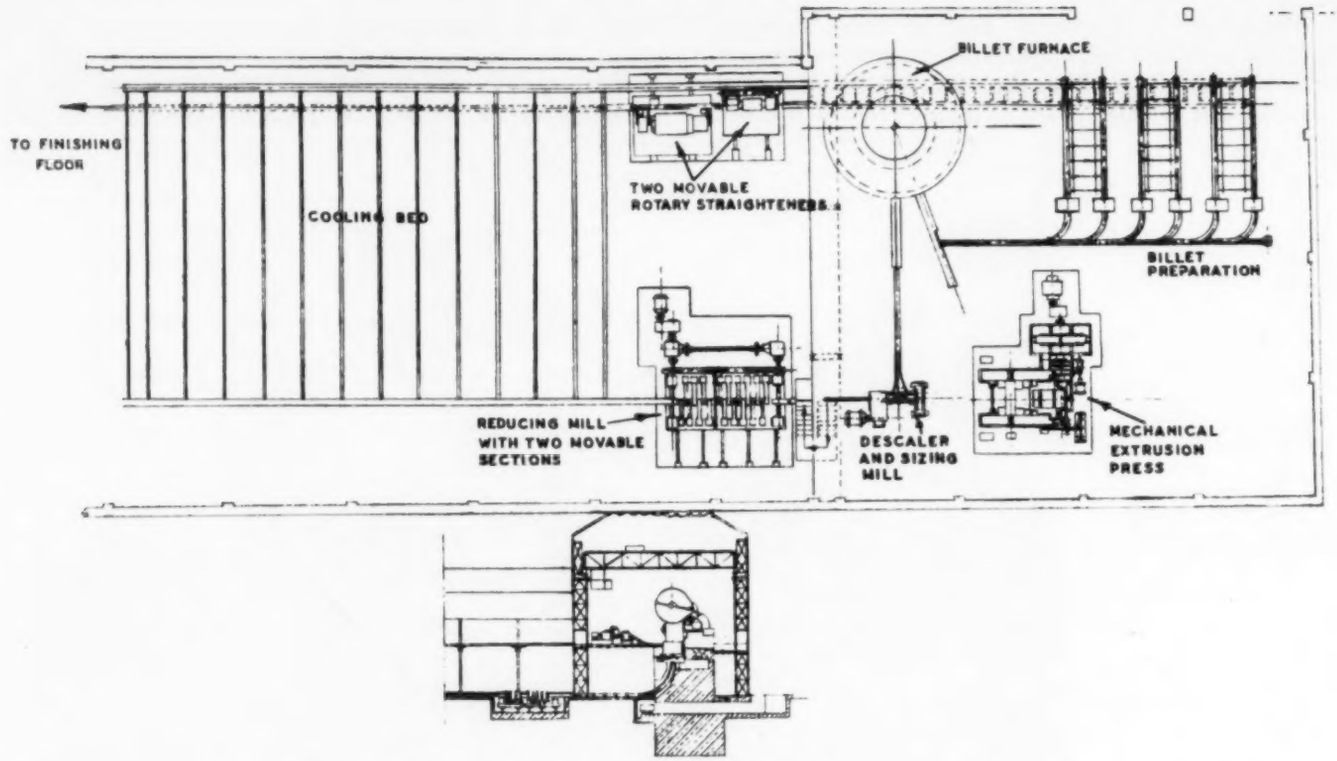


Figure 9 — General layout of hot mill for an extrusion press plant.

the press lubricator, the tube transporter, and the reducing mill operator, the cooling bed attendant, and the hot mill foreman.

PRESS OPERATING SCHEDULE

Under normal conditions the press extrudes a range of pipe sizes ⅜ up to 3-in. with wall thickness ranging from 0.09 to 0.20-in. This range includes the manufacture of all kinds of hot finished tubing, even at close wall tolerances. For example stainless steel of ASTM type 316 is extruded to tubes of 2½-in. outside diameter with 0.177-in. wall at wall tolerances of plus or minus 10 per cent. This is an actual production figure.

Table I shows a list of typical high alloy steels taken from the normal production schedule. Table II shows calculated data for the new 2200-ton press which are based upon past performance of the smaller presses. Tables III and IV are tabulations of actual production data for the 1500-ton press at Witten Works for gas and water pipe, and boiler tubing. From these data and other operating information it can readily be shown that the mechanical extrusion press is capable of producing tubing of wall thicknesses comparable with those of any known extrusion process.

It is important to note that all types of ordinary carbon and alloy steels, including the stainless grades, are extrudable by the mechanical extrusion process. The present known limits for steel extrusion are the special steels containing larger amounts of tungsten. The press has been used experimentally for extruding many of the non-ferrous alloys such as copper and aluminum, and it has also produced bars and shapes from both ferrous and non-ferrous materials.

An important advantage of the press is its ability to produce very high quality steel tubing from the lower cost steels. This is possible because of the extreme working of the material, which is due to the forging action of the piercing and extruding operations. Even the billet ends of the lower cost Thomas basic bessemer steels are used without difficulty. Round billets produced by the continuous casting process have also been extruded to seamless tubing by the mechanical extrusion press in Germany. The use of these lower cost steels is certainly an advantage which belongs exclusively to the mechanical extrusion process.

SPECIAL FEATURES OF THE MECHANICAL EXTRUSION PROCESS

The inherent design of this press produces the desired high speed of extrusion, as previously explained. Because of this high speed and other important design

Figure 10 — View shows reducing mill, outlet conveyor and cooling bed.

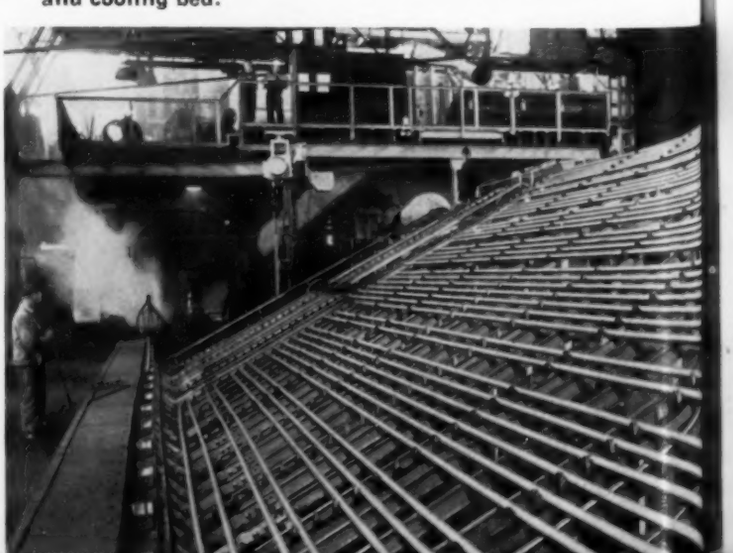


TABLE I

Typical High Alloy Steels from Normal Production Schedule

ASTM - Type	Characteristic analysis, per cent					Extruded tube	
	C max	Cr	Ni	Mo	Mn max	Outside diameter, in.	Wall thickness, in.
430 F	0.12	14-18	.....	....	1.25	2½	0.157
304	0.08	18-20	8-11	.....	2		
321	0.08	17-19	8-12	.....	2.5		
347	0.25	17-19	9-13	.....	2.5	2½	0.177
316	0.08	16-18	10-14	2-3	2		
316 Cb	0.10	16-18	10-14	2-3	2		

TABLE II

Typical Pressing Schedule for 2200-Ton Press

Billet		Extruded shell, in.	Hot finished tube, in.	Yield, per cent
Dimensions, in.	Weight, lb			
7⅛ x 16⅜	185	2⅝ x 0.219	2 x 0.250 x 414	87.5
7⅛ x 16⅜	185	2⅞ x 0.157	2⅜ x 0.190 x 456	89.0
7⅞ x 18⅛	250	3¼ x 0.250	2½ x 0.280 x 396	88.5
7⅞ x 18⅛	250	3 5/16 x 0.219	2⅞ x 0.250 x 382	90.0

features, the press has an output which is phenomenally high compared to other known steel extrusion methods. For instance, it is possible by this method to produce seamless steel tubing in practically all grades of steel at rates of from 120 to 180 tubes per hour, with an average continuous production rate of 140 tubes per hour, in lengths of up to 60 ft.

Presses now in operation are capable of extruding tubes up to 3-in. outside diameter. The minimum hot finished size is ⅜-in. pipe, which is made practical by use of the reducing mill in combination with the press. Even the ⅜-in. pipe can be produced in one furnace heat, from billet to hot finished tube, which is an outstanding advantage of the mechanical extrusion process. Heavier presses for producing larger sizes of tubing, as indicated previously, have also been developed.

The high operating speed of the mechanical extrusion press subjects the tooling to high temperatures and high pressures for a very short period of time, resulting in longer tool life and consequently lower tool cost for this process.

Lubrication for this process is relatively inexpensive. As indicated earlier, the most satisfactory lubricant for ordinary carbon steels is a mixture of graphite, oil and a low cost chemical ingredient. A similar mixture with some changes in ingredients, is used for stainless and some of the special alloy steels. During the early stages of development, some carburization of the steel was experienced, but with present day lubricants and operating practices, this is no longer a problem. Along with the fact that these lubricants have proven satisfactory in all respects, it is also important to note that no post-extrusion effort is required in cleaning the tools or the tubing. This is especially advantageous compared to the glass lubricating process, where considerable expense and time are involved in removing glass from the tubing and the tools.

The preparation of billets for this press is very simple; hot rolled or continuous cast steel rounds are ordinarily sawed or sheared to length and they are then ready for heating. Only in extruding certain high alloy and stainless steels is it necessary to remove surface defects by machining the rounds. Another principal advantage is the fact that no pre-piercing is required, nor is it necessary to use special salt-bath furnace or induction heating.

Since the billet is neither pre-pierced nor drilled, only outside descaling after heating is required, and for this purpose a simple roll-type scale-breaker is used between a conventional billet heating furnace and the press. This scale-breaker is used between a conventional billet heating furnace and the press. This scale-breaker also sizes the billet to suit the press billet receiver.

As explained previously, the driving power supply system provides for both a low total power consumption and a low peak power demand. The mechanical efficiency of the press combined with the most advantageous conditions for piercing and extruding, result in a minimum power cost per pound of extruded tubing.

Due to the consistent action of the mechanical press there is always a constant minimum billet remainder. A specially designed fixture also provides for easy removal and disposal of the billet residue.

As a result of years of operating experience, various developments in Germany and the best of design practices, mechanical extrusion press plants are now operating with the lowest possible maintenance cost. The use of mechanical press for this application thus eliminates the usual high maintenance costs of the large hydraulic power system required by other extrusion processes.

TABLE III

Pressing Schedule for 1500-Ton Mechanical Extrusion Press
Gas and Water Pipe

Hot Finished Pipe								
Pipe size — in., Nom	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2
Outside diam., in.	0.675	0.840	1.050	1.315	1.66	1.9	2.375	2.875
Wall, in.	0.091	0.109	0.113	0.113	0.14	0.145	0.154	0.203
Weight, lb/ft	0.57	0.85	1.13	1.68	2.28	2.73	3.68	5.82
Finished length, ft-in.	60	60	60	40	40	23	23	16-3
Total weight, lb	34.2	51	67.8	67.2	91.3	62.8	84.7	94.5
Scrap Ends								
Length, ft-in.	5	5	4	3	2	1-8	1-8	1-8
Weight, lb	2.85	4.25	4.52	5.04	4.56	4.55	6.13	9.70
Extruded Tube								
Outside diam, in.	1.66	1.95	2.075	2.365	2.49	2.635	2.8	3.4
Wall, in.	0.08	0.1	0.1	0.12	0.12	0.13	0.15	0.2
Mandrel								
Diam, in.	1 1/2	1 3/4	1 7/8	2 1/8	2 1/4	2 3/8	2 1/2	3
Billet								
Outside diam, in.	4 3/4	5 1/8	5 1/2	5 1/2	6	5 1/2	6	6 1/2
Weight, lb	40.2	59	77.5	78.2	103	74.5	100	116
Billet After Piercing								
Outside diam, in.	4 3/4	5 1/8	5 1/2	5 1/2	6	5 1/2	6	6 1/2
Wall, in.	1.625	1.688	1.813	1.688	1.875	1.563	1.75	1.75
Length (cold), in.	8.5	10.4	12.35	12.33	14.2	12.5	14.15	14.2
Pressure								
Net tons	840	874	1035	905	1135	812	954	955
Yield, per cent	84.8	86.5	87.5	86	88.7	84.4	84.7	81

TABLE IV

Pressing Schedule for 1500-Ton Mechanical Extrusion Press
Boiler Tubing

Hot Finished Sizes									
Outside diam, in.	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/4	2 1/2	2 3/4	3
Wall, in.	0.095	0.095	0.095	0.095	0.095	0.105	0.12	0.12	0.12
Weight, lb/ft	1.426	1.552	1.679	1.806	1.933	2.405	3.05	3.371	3.691
Finished length, ft	40	40	40	40	23	23	23	23	23
Total weight, lb	56.9	61.9	67.1	72.1	44.4	55.3	70.0	77.3	81.2
Scrap Ends									
Length, ft-in.	3	2-3 1/2	2	2	1-8	1-8	1-8	1-8	1-8
Weight, lb	4.28	3.57	3.35	3.51	3.22	4.01	5.08	5.70	6.15
Extruded Tube									
Outside diam, in.	2.18	2.18	2.31	2.44	2.56	2.71	2.98	3.35	3.61
Wall, in.	0.093	0.093	0.095	0.095	0.095	0.105	0.115	0.115	0.115
Mandrel									
Diam, in.	2	2	2 1/8	2 1/4	2 3/8	2 1/2	2 3/4	3 1/8	3 3/8
Billet									
Outside diam, in.	5 1/2	5 1/2	5 1/2	5 1/2	5 1/8	5 1/2	6	6 1/2	6 1/2
Weight, lb	66	70.4	75.5	82.0	36.8	66.5	84.2	95.7	102.3
Billet After Piercing									
Outside diam, in.	5 1/2	5 1/2	5 1/2	5 1/2	5 1/8	5 1/2	6	6 1/2	6 1/2
Wall, in.	1.725	1.725	1.688	1.625	1.375	1.5	1.625	1.688	1.563
Length (cold), in.	10.7	11.5	12.4	13.8	10.5	11.3	12.2	11.8	11.9
Pressure									
Net tons	1031	1031	985	937	710	827	973	1116	1018
Yield, per cent	86	88	89	88	82.8	83.2	83.2	80.7	79.5

OUTPUT

Based upon an average production rate of 140 tubes per hour, a billet weight of 100 lb, and a yield of 84 per cent a nominal output of a 1200-ton mechanical press would be 5.9 tons per hour of hot finished tubes.

With the new 2200-ton press now available, when using a 250-lb billet, and with mechanical handling facilities, the same production rate and a yield of 88 per cent would produce 15.4 tons per hour output.

Due to the many operating advantages of the mechanical extrusion process, it is the lowest cost method known for producing small diameter seamless steel tubing in practically all grades of steel. As one of the

many promising future possibilities for this process, it is expected that the combination of the continuous casting of round billets with this type of extrusion press will result in the lowest overall production cost for commercial seamless steel tubing.

DISCUSSION

PRESENTED BY

A. B. CAPRON, Chief Engineer and Assistant Works Manager, Tubular Products Div., The Babcock and Wilcox Co., Beaver Falls, Pa.

ASTOR L. THURMAN, Executive Vice President, Mannesmann-Meer Engineering and Construction Co., Inc., Easton, Pa.

A. B. Capron: Many representatives of companies having extrusion presses in this country have seen the mechanical press installation at Witten, Germany, and I feel sure that all of us were impressed by the speed of the press operation and its production in pieces per hour. I have no doubt that a vertical mechanical press has advantages over a horizontal hydraulic press in certain types of product, especially in small section solid extrusions where the high production rate can be utilized. On tubular extrusions, however, especially on the stainless grades, on which we have had all of our experience, we feel there are many factors which could be troublesome if a mechanical press were used and perhaps Mr. Thurman can clear up some of my doubts on these points.

I know this new 2200-ton press has a 67-in. stroke and if the same design used in the 1,000-ton presses in Witten has been used on this press, the entire extrusion stroke takes place in about a 60 degree arc, from 4 o'clock to 6 o'clock. This would, according to my figures, limit the billet length to a maximum of 15-in. which, on a 250-lb billet, would mean a billet diameter of approximately 8¼-in. We use a ratio of 7 to 1 in relating minimum piercing mandrel diameter to billet length, which would mean that the minimum piercing mandrel usable on the 15-in. long billet would be 2⅛-in., and therefore the smallest tube producible from this 250-lb billet would be around 2⅜-in. diameter. With this 2⅛-in. minimum diameter of piercing mandrel in mind, the 88 per cent yield figure you gave seems quite high. I would be interested to know if you have found some way to pierce and extrude a smaller size tube while using the maximum billet length.

Most of the new hydraulic presses in this country have been built primarily for stainless steel, and the use of glass as a lubricant has eliminated the problem of carburization. We have found the effects of carburization, when very slight amounts of carbonaceous materials have come in contact with the hot billet during various stages of the extrusion operation. I know that stainless has been pierced on the Witten press using grease and graphite as a lubricant and it has also been extruded with the same lubricant on horizontal hydraulic presses in England, and these producers have told us that they have no carburization problems. It may be that European standards of perfection are completely different from ours or that the carbon limits on the stainless grades are different and that they overlook what we term carburization. I do know, however, that our laboratory detected carburization on tubes made with fiberglass lubrication where the binder in the fiberglass pad apparently provided enough carbon to contaminate the stainless tube. I would like to have a little further information on this point.

Differences in American and European standards may also affect the acceptance or rejection of surface quality off a mechanical extrusion press using grease and graphite as a lubricant. The operating costs of a horizontal hydraulic extrusion press is admittedly higher per ton than the normal hot mill process, and because of this we must get a vastly superior surface off the extrusion press to balance the higher cost. I have seen both stainless and carbon tubing produced on a mechanical press, and I feel that the surface is better when glass lubrication is used. Since practically all of the stainless tubing sold in this country is sold as cold drawn tubing, the surface of the hot rolled or extruded product must either be conditioned, or be good enough not to need conditioning before it is cold drawn. We expect a much smaller tube off the extrusion press than off a hot mill to reduce the cold drawing cost and, therefore, want a tube which is practically perfect on both outside and inside diameters and which has to be perfect inside because the inside diameter is too small to be conditioned. I think that the average surface condition found in tubing off a press using glass as a lubricant is better than that produced with oil and graphite lubrication.

The new design of drive set forth in the paper is interesting. I am not clear how you handle the deceleration of the d-c motor drive at the end of the stroke. The elimination of the clutch, however, would certainly be advantageous from a maintenance standpoint.

The mechanical extrusion press certainly has advantages in certain features over the horizontal hydraulic press. I am sure all of us look forward to the day when the good points in both types can be combined in one unit, and a faster, better, and more economical extrusion press is developed for both solid and tubular extrusion.

Astor L. Thurman: To answer Mr. Capron's first question, the new press design uses a little more than 90 degrees for the extrusion stroke; thus the 250-lb billet will have a length of 18⅛ in. and a diameter of 7⅞ in. Although the mandrel is very well guided, we also use 7 to 1 as the best limit for the ratio of piercing mandrel diameter to billet length. Thus our minimum tube diameter would be about 2½ in. when using a billet diameter of 7⅞ in. As indicated by the tabulation of Table II, this diameter and billet length have been used for producing 2½ and 2⅞-in. outside diameter tubing and in this case the mandrel diameter was about 2¾ in. For these two sizes the yield would be 88.5 and 90.0 per cent.

For making 2⅜-in. tubing the billet diameter is decreased and the billet receiver is changed to suit, but the yield for this size is still 89.3 per cent. The inherent characteristics of this press provide a constant minimum billet remainder and the yield is therefore higher than would be expected from other types of extrusion

presses. Tables III and IV show instances of high yield, even when using a billet weighing, in most cases, under 100 pounds.

It is of course, necessary to use a reducing mill following the extrusion press in order to produce some of the many finished sizes shown in Tables II, III, and IV.

As for carburization of the surface of the tube, this is no longer a problem with the lubricant now being used at Witten. As indicated, we do not use glass lubricants but they will guarantee that there will be no carburization when the proper lubricant and extrusion techniques are employed. Witten Works have produced even the very low carbon stainless steels with no carburization, without difficulty.

As indicated in the body of the paper, if for any reason, glass lubricant should be preferred, the press operating frequency can readily be adjusted to suit the characteristics of the glass lubricant and the benefits of this type of lubricant can be obtained as well. Nevertheless, operating techniques and lubricants for the mechanical extrusion press have been vastly improved, even in the last year, and the surface quality of the product has been improved accordingly. We have recognized the need for a high quality surface on the extruded product, and because of the high rate of production can now economically produce a hot finished tube which will meet these requirements.

To explain the press speed curve shown in Figure 8, only 90 degrees of the press speed is shown. Prior to this time the press ram speed has been following a resultant of the normal crank motion at constant speed and the varying speed of the motor. At the 90 degrees position, the press downward motion at constant motor speed would normally be at a maximum, but this has been offset by having decelerated the driving motor speed to a low value. At constant motor speed from that point, the press downward motion would decrease in speed until at 180 degrees its speed becomes zero. The acceleration of the main drive motor compensates for this drop in speed, and thus maintains a constant downward speed of the press ram until the motor has accelerated to its top speed. At that point the press ram speed must approach zero as it approaches dead center. Thus the press speed curve follows its normal constant motor speed curve to zero at that point. On the return stroke the driving motor runs at constant top speed and the press ram and mandrel are returned to top dead center in the shortest possible time. At the end of the cycle, of course, the main motor must come to rest and this deceleration to zero motor speed is accomplished by controlled regeneration braking of the motor. With the type of controls available today, it is no problem to stop the press on top dead center on every stroke.

As indicated in this paper, however, in spite of the flexibility of this new drive, in most cases it is best to use a constant speed motor for driving the press, so that full advantage may be obtained from the crank motion; that is, to provide the highest possible speed at the start of the piercing and extruding cycles.

Mr. Capron is to be very highly commended for the precise manner in which he has high-lighted many of the salient points of the mechanical extrusion process. I know that we all join him in hoping for even better methods for extrusion of steel products. We supply both mechanical and hydraulic extrusion presses and as our contribution to the art and science of the extrusion of metals, we pledge our continued efforts toward the proper application and improvement of each type of press.

AISE WEST COAST MEETING

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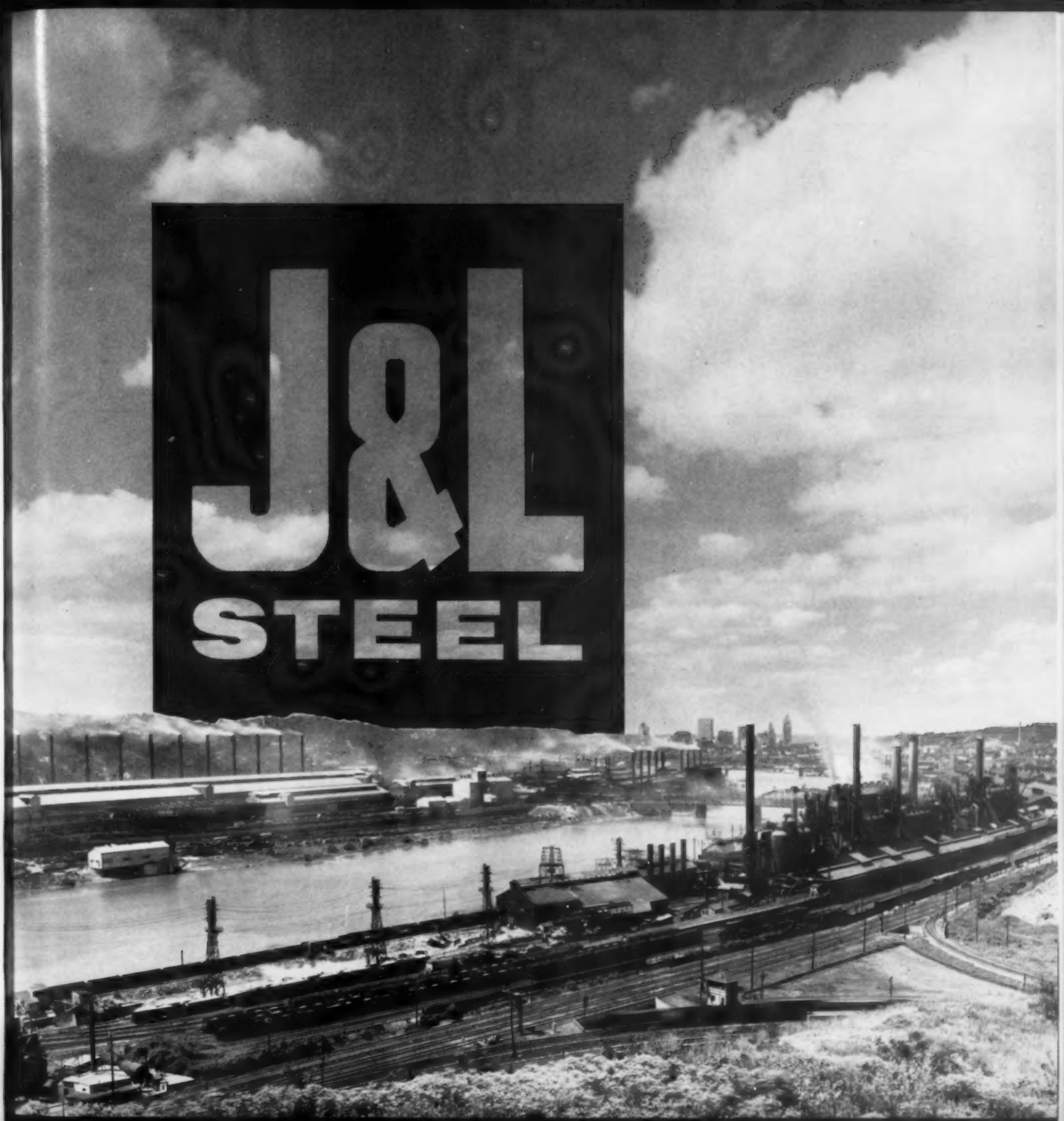


Jones & Laughlin . . .

PITTSBURGH WORKS

Jones & Laughlin...

PITTSBURGH WORKS

by T. J. Ess

▲ SOMETHING more than a century ago, Pittsburgh was truly the gateway to the West, and the roots of its growth as an industrial center were already taking firm hold, nourished by the requirements of settlers on their westward trek.

In 1853, B. F. Jones, Samuel Kier, Bernard Lauth and John F. Lauth established the firm of Jones, Lauth & Company to operate the American Iron Works, located on one and one-half acres of land on the south side of the Monongahela River. The original plant consisted of four puddling furnaces, a squeezer, muck rolls, two heating furnaces and a guide mill. Output was about seven tons per shift. The firm prospered and by 1857 was making about 6000 tons per year of wrought iron bar and cut nails.

In 1859 James Laughlin, who had become a partner in Jones & Lauth, acquired land on the north side of the Monongahela River, opposite the Jones & Lauth plant, formed Laughlin and Company, and began construction of bee-hive coke ovens and the first two Eliza blast furnaces.

In 1861, the firm of Jones and Laughlins was formed to succeed Jones and Lauth, and for the next 40 years Jones and Laughlins and Laughlin and Company, with substantially common ownership, continued operations on opposite sides of the river. Pig iron from the Eliza furnaces was ferried across the river until a bridge was built in 1877. By this time the South Side plant had grown to 75 puddling furnaces, 30 heating furnaces, 18 trains of rolls and 73 nail machines, with a capacity of 50,000 tons per year, while the Eliza furnaces had an annual capacity of 36,000 tons of pig iron.

With the development of the bessemer process, steel began to replace wrought iron, and in 1886 Jones and Laughlins installed two seven-ton converters, while Laughlin and Company built a third blast furnace. Eight years later, the company abandoned their puddling furnaces and went out of the wrought iron business.

Since iron was cast into pigs in sand beds at the blast

ADMIRAL BEN MOREELL
CHAIRMAN OF THE BOARD

The company-owned Hill Annex mine, on the Mesabi Range, is a major source of iron ore.

furnaces, it was necessary to remelt the iron for the converters. This was done in cupolas, and even after the development of mixers and facilities for handling the molten iron, Jones and Laughlins used cupolas to melt purchased pig iron. It was not until 1920, when blast furnace capacity caught up to the demands of the steel plant, that cupola operation was discontinued in this plant.

During World War I two ten-ton converters were added, and the original vessels were modified to 12½-ton capacity. In 1929, all of these were replaced by two 25-ton vessels on the south side of the river. A third converter was added in 1948.

Jones and Laughlins entered the open hearth field in 1895, constructing six 40-ton furnaces which operated on cold charges. Five years later they adopted the Talbot process, and by 1911 had nine tilting open hearth furnaces at Pittsburgh with bath capacities of 200-300 tons. These furnaces averaged only five to eight tons per furnace hour. Dissatisfaction with the Talbot process led to the introduction of the duplex process, and the last Talbot heat was made in 1924.

As scrap became more available, additional open hearth furnaces were built for the conventional iron-scrap charge, and in 1952, the duplex process was abandoned at Pittsburgh Works and the bessemer converters were shut down. In the same year, six 65-ton cold charge open hearth furnaces, built on the north side of the river in 1917, were also abandoned.

In 1900, Jones & Laughlins, Ltd., and Laughlin and Company, Ltd., were consolidated, and two years later the business was incorporated as Jones & Laughlin Steel Company. By that time the company had an annual capacity of more than 1,000,000 tons of steel ingots. Blast furnace capacity expanded, and with six furnaces reached a capacity of 1,035,000 tons per year by 1904.

Following this merger, a program of acquiring raw material sources was actively pursued, a particularly desirable course in view of the start of construction of a new plant at Aliquippa, Pa. in 1907. Through purchases and leases, the Vesta and Shannopin coal lands were obtained, as well as the Martinsburg limestone quarries, ore deposits in Minnesota and Michigan, and other properties. In 1940, development of the Benson ore mines in New York was begun.

In 1923 the company was reorganized into its present corporate form, and after the depression of the "thirties," it joined in the revolution in flat product rolling methods by installing continuous hot and cold strip mills. The assets of Otis Steel Co. in Cleveland, Ohio, were acquired in 1942 through an exchange of stock.

The development of Jones and Laughlin Steel Corp is particularly interesting because, except for the Otis acquisition, all its growth came from expansion of its own plants. Furthermore, a major portion of the expansion was financed from the company's own earnings. An interesting provision of the original partnership agreement stated that all profits of the firm for the first five years were to become part of the firm's capital stock. Over the years, approximately 70 per cent of the company earnings have been reinvested in the business. It was not until 1951 that the company sold an issue of common stock.

Since World War II, extensive modernization has taken place at Pittsburgh Works, including a new open hearth shop, a new blooming mill, a new bar mill, and the expansion of various other facilities.

As it is now constituted, the Pittsburgh Works has six batteries of by-product coke ovens with a total capacity of 1,518,000 tons of coke per year, six blast furnaces totaling 1,927,000 tons of iron in annual capacity, 21 open hearth furnaces with a combined annual capacity of 3,097,500 tons of ingots, two blooming mills, two billet mills, two merchant mills, a continuous wide strip mill, and the necessary finishing and auxiliary facilities.

The plant straddles the Monongahela River, occupy-

Ore from the Benson mines, at Star Lake, N. Y., is beneficiated in this plant which has a capacity of 1,600,000 tons per year.

C. L. AUSTIN
PRESIDENT

A. J. HAZLETT
EXECUTIVE VICE PRESIDENT

ing 276 acres all within the city limits of Pittsburgh. The coke plant, blast furnaces, bar mills, strip mills and cold finishing units are on the north side of the river, with open hearths, blooming and billet mills and shops on the south side. The two sections are connected by a bridge carrying three railroad tracks, one of which is used exclusively for hot metal trains.

RAW MATERIALS

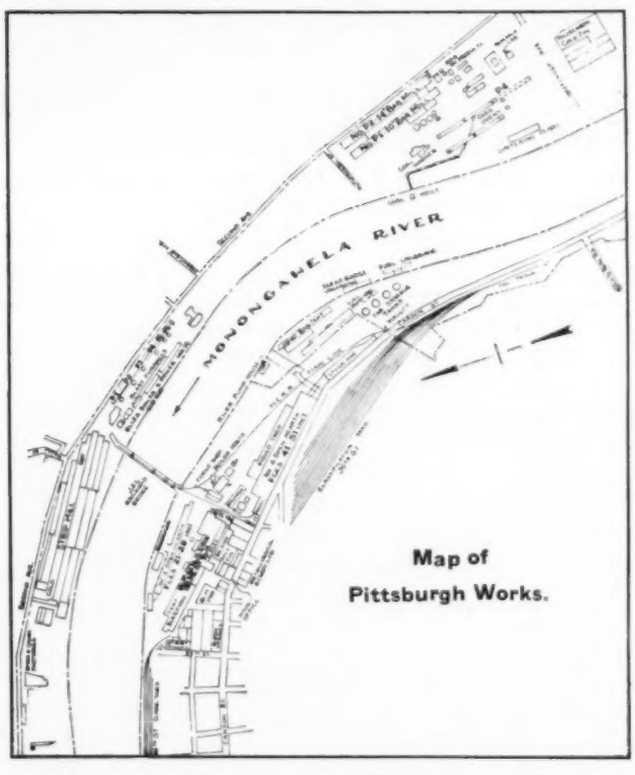
Iron ore comes to the plant from two principal sources. The greater part, stemming from the Mesabi, Marquette, Menominee and Cuyuna ranges, is shipped from the upper Lake ports and is either stored at the lower Lake ports or loaded directly into railroad cars for shipment to the plant. The remainder of the ore consists of sinter produced in the plant and sinter received from the Benson mine in New York. Table I shows analyses of the various ores used.

At the Minnesota Ore Division, the production of the various company-owned mines is mixed in varying proportions to form the ore groups listed in Table I. These mines have facilities for crushing, screening and washing ore. One mine also has a heavy media separation plant. With full steel plant operation, these mines send out about 3,400,000 tons of ore per year. In addition, approximately 2,000,000 tons of ore is purchased.

The company is opening a new underground mine, the Tracy mine at Negaunee, Mich. It will have a capacity of 1,000,000 tons per year.

At the New York Ore Division, the crude ore (principally magnetite is beneficiated and the resultant concentrates, which contain about 7.5 per cent moisture, are agglomerated by sintering. The capacity of this plant has recently been increased to 1,600,000 tons per year.

All ore arrives at the plant by rail and is normally unloaded directly into the blast furnace bins. Except for a reserve pile of about 80,000 tons for emergencies, no ore storage is available at the plant. When necessary, this ore may be reclaimed for use by diesel-powered bucket crane or power shovel.



Map of
Pittsburgh Works.

With full operation, the Pittsburgh Works uses approximately 2,735,000 gross tons of ore per year, with about 70 per cent coming from the Lakes area and 30 per cent from the New York ore division.

Limestone and dolomite come principally from the company's Blair Limestone Division, with quarries at Martinsburg and Millville, W. Va. At both quarries, the products are crushed, screened and washed. Analyses of the products are given in Table II. In addition, some limestone is purchased from various quarries in Pennsylvania.

At both Martinsburg and Millville, vertical kilns are operated to produce single burnt limestone and dolomite, principally for the company's Aliquippa Works.

All limestone for the blast furnaces at Pittsburgh Works comes from the Martinsburg and Millville quarries. Limestone for the open hearths at Pittsburgh Works is purchased from outside quarries.

Coal originates chiefly in company-owned mines operated by the Vesta-Shannopin Coal Division, with mines in Washington and Greene Counties in south-

A. T. LAWSON
VICE PRESIDENT—
PRODUCTION

W. P. GETTY
ASS'T. VICE PRESIDENT—
PRODUCTION

TABLE I

Iron Ore Analyses

Source	Ore	Per cent (Dry)							Per cent moisture
		Iron	Silica	Phos-phorus	Man-ganese	Alumina	Lime	Mag-nesia	Sulphur	
Minnesota Ore Division										
Mesabi Range	Blain Group	51.57	10.20	0.084	0.43	1.51	0.14	0.10	0.020	10.18
	Cauby Group	52.96	12.26	0.041	0.36	0.72	0.12	0.09	0.017	8.15
	Classifier Group	50.65	12.58	0.057	0.46	1.39	0.14	0.11	0.014	10.45
	Locoma Group	47.87	10.14	0.081	1.58	2.36	0.16	0.12	0.017	12.18
New York Ore Division										
Benson Mine	Magnetite Sinter	61.38	7.59	0.030	0.31	3.52	0.21	0.37	0.31	.....
	Martite Sinter	59.42	7.29	0.204	0.12	3.17	0.66	0.29	0.19	.....
Plant sinter	.....	57.25	9.95	0.080	0.78	.....	.....	.....	.....	.....
Purchased ores										
Mesabi Range	Newberry	53.04	12.53	0.037	0.28	0.51	0.28	0.15	0.014	6.74
	Williamson	51.52	12.18	0.066	0.37	1.24	0.23	0.16	0.018	8.50
	Cherry	49.08	10.72	0.074	1.44	1.74	0.28	0.15	0.022	11.05
Marquette Range	Cliffs Group	51.26	9.77	0.103	.....	2.03	.....	.....	.....	10.22
	Lump Cliffs Shaft	59.18	9.82	0.115	0.33	1.91	0.73	0.69	0.012	0.30
Menominee Range	Hickory	48.92	6.10	0.514	1.99	2.53	2.94	1.50	0.072	7.04
	Sagamore	41.17	12.31	0.225	5.61	2.63	0.62	0.27	0.029	11.47
	Bristwood	45.49	9.49	0.437	2.86	3.70	.....	.....	.....	8.92
Cuyuna Range	Alstead	43.28	12.89	0.177	4.20	2.43	0.35	0.17	0.012	10.58

western Pennsylvania, and the Twin Branch-Black Eagle Coal Division, with mines in Wyoming and McDowell Counties in West Virginia.

The Vesta mines, located near Fredericktown, Pa., produce about 20,000 tons per day under full operations. This coal is washed in a preparation plant at the mines. It is used for coking, with the exception of middlings which are separated out and used as steam coal.

Shannopin mine, near Poland, Pa., provides the major portion of the steam coal. Daily production runs about 3000 tons per day, which is hand picked before shipment.

Low volatile coal comes principally from the Black Eagle mine in Wyoming County, W. Va., which produces about 1300 tons per day. This coal is also hand picked before shipment. Some low volatile coal is also purchased from the Tams, W. Va., area.

Table III shows typical analyses of the coals used.

All coal arrives at the plant by river barges and is unloaded at either of two stations. One station adjacent to the coke plant is equipped with a double bucket elevator which lifts coal from the barges and places it either upon a belt conveyor leading to the coal handling station at the coke plant, or into railroad cars which move it to a nearby stocking area. Here the coal is unloaded by track hopper, conveyors and trucks, and bull-dozed to a height of 30 ft. This storage covers 97,500 sq ft and holds 65,000 tons of coal.

From this storage, coal is loaded by bulldozer and

Drilling machine in operation at the Vesta No. 4 coal mine, in Washington County, Pa.

Coal from the Vesta mines — about 20,000 tons per day — is washed in this preparation plant.

TABLE II

Limestone and Dolomite Analyses

	Limestone Martinsburg		Dolomite Millville	
	No. 1	No. 3	No. 2	No. 4
SiO_2	1.71	1.44	2.03	1.68
R_2O_3	0.92	0.90	1.22	1.18
CaO	50.35	52.47	30.61	30.33
MgO	3.52	2.25	20.07	20.54
P	0.010	0.009	0.009	0.009
S	0.075	0.079	0.066	0.059

TABLE III

Typical Coal Analyses

	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur
Vesta-Shannopin Division					
Vesta washed	8.0	35.37	56.87	7.76	1.33
Vesta steam	5.6	33.3	50.4	16.30	2.80
Shannopin	3.3	36.94	52.89	10.17	3.46
Twin-Branch Black-Eagle Division					
Twin Branch	4.4	21.72	72.73	5.55	0.71
Black Eagle	4.4	19.80	73.29	6.91	0.75
Purchased Coal					
Tams	5.39	17.54	76.91	5.55	0.78

mobile shovel crane into railroad cars which are moved to the track hopper at the coal handling station of the coke plant.

Steam coal is unloaded from the barges into railroad cars which then carry the coal to those boilerhouses which use coal.

Another storage area about two or three miles downriver from the coke plant covers 27 acres and has a capacity of 1,000,000 tons of coal. Here, barges are unloaded by a mobile crane with a 4-cu yd bucket and the coal is moved by trucks to the pile where it is bulldozed to a height of 30 ft. Coal is reclaimed from this storage by mobile crane and trucks, and is chuted into barges which are then moved to the unloading station at the coke plant.

Under full operation, the Pittsburgh Works sets up a daily demand of about 5000 tons of high volatile coking coal, 825 tons of low volatile coking coal, and 600 tons of steam coal.

COKE PLANT

At the coke plant, coal first passes through a primary crusher, where it is reduced to —3 in. It is then conveyed to three 500-ton mixing bins, two for the high volatile Vesta coal, one for low volatile coal.

From these bins, the two types of coal are fed in weighed amounts (usually 85 per cent high volatile, 15 per cent low volatile) to a gathering conveyor which carries them to a crusher where the mixture is further reduced so that 55 per cent will pass through a $\frac{1}{8}$-in. screen. Belt conveyors then move the crushed coal mixture to the oven storage bins. There are three of these bins, two of 3000 tons and one of 2400 tons capacity.

Six batteries of coke ovens, arranged in two parallel rows, provide a coking capacity of 6400 net tons of coal per day. Five batteries, of gun flue construction, contain 60 ovens each, 37 ft long, 9 ft $10\frac{3}{8}$ in. high and $15\frac{3}{4}$ to $18\frac{1}{4}$ in. wide. Each of these ovens take a normal coal charge of 10.8 net tons of coal. Doors are sealed by luting with clay.

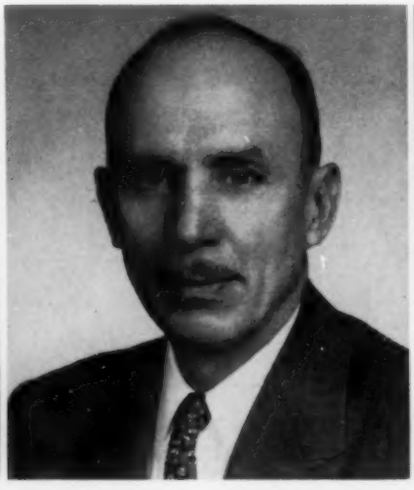
The other battery, of more recent construction, consists of 79 ovens 40 ft $6\frac{1}{2}$ in. long, 13 ft high and $15\frac{1}{4}$ to $18\frac{3}{4}$ in. wide. These ovens are of underjet, cross regenerative recirculating design and take a normal coal charge of 16.73 net tons of coal each. These ovens have self-sealing doors.

All of the oven batteries are underfired with straight coke oven gas, using about 43 per cent of the total gas make. The older batteries operate with two millimeters pressure and 2150 F temperature in the ovens, one millimeter pressure and 2550 F temperature in the flues, and $10\frac{1}{2}$ millimeters suction and 425 F temperature at the stack. The new battery operates with $5\frac{1}{2}$ millimeters and 2200 F in the ovens, 3 millimeters and 2600 F in the flues, and 15 millimeters suction, 590 F at the stack. Gross coking time ranges 17-18 hours. Normally, 491 ovens are pushed per day, with a possible maximum of 535 ovens per day.

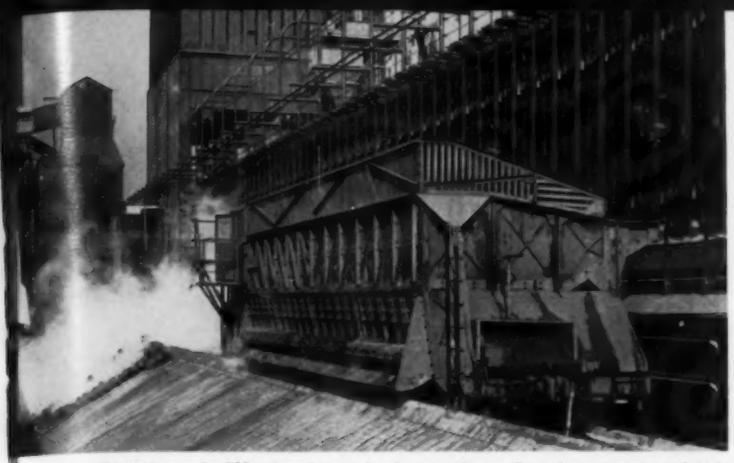
W. H. LEWIS
WORKS MANAGER

H. P. SAXER
ASS'T. WORKS MANAGER — PRODUCTION

N. C. ATWOOD
ASS'T. TO WORKS MANAGER — GENERAL SERVICES



P. N. WALTER
ASS'T. TO WORKS MANAGER — PERSONNEL RELATIONS



Pittsburgh Works has six batteries of coke ovens which provide a coking capacity of 6400 tons of coal per day.

A three-hopper larry car operates on top of each battery, conveying just enough coal for an oven charge from the storage bins to the ovens.

Each battery is served by a pusher machine which also carries a leveling bar and a door machine. On the coke side of each battery, another door machine travels along the battery, handling the doors on that side.

There are three quenching towers, two of brick construction, one of sheathed wood. Six quenching cars carry the coke from the ovens to the towers. Quenching is automatic, with electric timers. The water is recirculated.

The quenched coke is dumped on one of three wharves to cool, and is then carried by belt conveyors to one of three coke screening stations. Coke passing over a 7/8-in. screen is used as furnace coke, the smaller sizes going to nut coke and breeze.

From the screening station, coke is conveyed to the blast furnaces in 50-ton high-side, bottom-dump railroad cars.

Complete equipment is provided for the recovery of the conventional by-products. As the gas leaves the ovens at a temperature of about 1200 F, it is subjected to sprays of cool ammonia liquor, condensing heavy pitch-like material and much of the tar. The gas collecting mains are sloped so that this material as well as the ammonia liquor drains to one end and flows to the hot-drain tank.

The gas passes on through the suction mains to the primary coolers. Just ahead of the coolers, traps in the suction mains remove additional tar and ammonia liquor that have condensed. The primary coolers are multi-pass shell and tube heat exchangers, with cooling water passing through the tubes and gas flowing around the tubes. These units reduce the gas temperature from about 175 F to 85-95 F, condensing more ammonia liquor and tar which are piped to the hot drain tank.

Four steam-driven exhausters, with tar extractors, maintain suction on the oven mains. From the exhausters, the gas passes through reheaters, ammonia scrubbers and final coolers.

The gas next flows through two light oil scrubbers, 100 ft high × 18 ft in diameter, in series. Each scrubber contains nine oil sprays, which absorb light oils from the gas. The gas, free of all by-products, flows to a 40,000-cu ft gas holder.

From the holder fuel gas goes to the ovens for heating while surplus gas is sent to the consuming departments of the steel plant. Three steam-driven boosters move the gas through this distribution system.

Leaving the scrubbers, the absorbent wash oil carries about 2 per cent by weight of light oil, and flows to a stripping still where a controlled amount of live steam "sweeps" the light oil from the wash oil. The debenzolized wash oil is then pumped through coolers and circulated back to the scrubbers, while the mixed steam and light oil vapors flow to a light oil rectifier. Here the light oil is separated into two components. The heavier portion is drawn off as a liquid and pumped to a storage tank for subsequent processing.

The lighter portion leaves as a vapor, is then condensed and separated from accompanying water, and then pumped to a carbon-disulphide column, where it is again separated into two components. The forerunning vapors leaving this column pass through a condenser. Gases are vented off into the oven fuel gas main. The liquid component from this column, consisting of benzol, toluol and xylol, is drawn off the bottom, cooled, and stored for further processing.

The units mentioned above operate continuously, 24 hours a day. Further processing is carried on in batch type stills. The heavier component from the rectifier column is put through the crude still to obtain crude solvent.

The benzol-toluol-xylol component is washed with sulphuric acid in an agitator, and then washed with caustic soda solution. This removes certain impurities which may cause discoloration of the light oils. The oil is then fractionated into benzol, toluol and xylol in the pure products still.

Equipment is also installed to recover phenol from the ammonia liquor, and pyridine and picoline from the gas.

Coke produced has an average analysis about as follows:

	Per cent
Volatile matter	0.90
Fixed carbon	89.08
Ash	10.02
Sulphur	1.02

Coke yield runs about 69.45 per cent furnace coke and 4.89 per cent coke breeze. By-product recoveries average 10,777 cu ft of gas, 11.06 gal of tar, 33 gal of Ammonia liquor, and 3.32 gal of light oil per net ton of coal coked.

Tar is further processed to give 23 per cent of tar acid oil, 2 per cent of creosote, and 70.5 per cent residual tar. In addition to the tar produced at Pittsburgh Works, about 2,500,000 gal of raw tar per month is brought from Aliquippa Works to be processed here. Ammonia liquor is used to form ammonium sulphate, amounting to 20.5 lb of ammonium sulphate per ton of coal coked. Fractionation of the light oil yields about 63.6 per cent benzol, 18.4 per cent toluol, 7.0 per cent xylol, 4.6 per cent solvent, and 6.4 per cent residue.

BLAST FURNACES

Basic iron is produced in six blast furnaces aligned along the north bank of the Monongahela River. Principal design and operating characteristics of these furnaces are given in Table IV.

The hearths of all furnaces are cooled by cast steel

staves 15 ft long except on No. 2 furnace, where they are 11 ft 7 in. long. Conventional bronze cooling plates are carried up through the hearth and bosh walls. No cooling plates are used above the mantle. Steel castings built into the brickwork provide stockline protection.

All furnaces are equipped with double skip hoists, motor-operated. All skip cars dump into rotating distributor tops and all bell hoists are operated by steam.

Charging sequences vary, the more commonly used being ooscce/, occsoc/oscc/, or occooscc/. Automatic sequence control is installed on No. 1, 3, 5 and 6 furnaces. Coke is charged by volume, ore and stone by weight.

The six furnaces are served by a continuous high line carrying two tracks, running over a double row of bins. An active storage of 6800 tons of iron ore and sinter is provided by 68 bins, each of 100 tons capacity, while 55 bins each hold 80 tons of stone, for an active storage capacity of 4400 tons. Ore, sinter and limestone are unloaded directly from railroad hopper cars into the bins the year around. Four mechanical shaker units are used in unloading the cars.

Coke coming from the coke plant is dumped into a 150-ton bin on the centerline of each furnace. A shaker screen beneath each of these bins removes fines as the coke flows into the skip cars.

Blast for the furnace is provided by two turboblowers rated at 75,000 cfm at 30 psi pressure, two turboblowers rated at 100,000 cfm at 30 psi pressure, five double vertical blowing engines with 87 in. × 60-in. air tubs rated at 40,000 cfm, five similar engines with 84 in. × 60 in. air tubs rated at 33,000 cfm, and one double horizontal blowing engine with 84 in. × 48 in. air tubs rated at 33,000 cfm. The blowers are so cross-connected that they may be used on various furnaces, providing protection in case of failure of any blowing unit.

TABLE IV

Blast Furnace Dimensions

Furnace No.	1	2	3	4	5	6
Diameter of hearth, ft-in.	20-6	21-6	24-6	19-0	19-3	24-0
Diameter of bosh, ft-in.	23-6	24-0	26-11	22-6	22-6	28-0
Diameter of stockline, ft-in.	18-0	18-6	19-0	17-0	17-0	19-0
Height, iron notch to stockline, ft-in.	86-2½	86-5	86-2¾	87-2½	82-9¼	82-0
Height of crucible, ft-in.	10-9½	9-9½	10-9½	10-6½	11-3½	11-3½
Height of bosh, ft-in.	10-10½	12-4½	9-5¾	12-4½	9-6¼	12-4½
Height of straight section, ft-in.	7-6	7-0	6-0¼	9-0	8-3⅛	6-0
Height of inwall section, ft-in.	45-0	44-0	46-6	44-0	43-10⅜	48-3
Height, stockline section to top ring, ft-in.	12-1	14-10½	13-8	14-3	13-3 13/16	6-2
Height, bottom to iron notch, ft-in.	2-0½	1-0½	2-0½	1-9½	2-0½	2-0½
Height, iron notch to cinder notch, ft-in.	3-7½	3-9½	3-9½	4-6½	3-9½	3-9½
Height, cinder notch to tuyeres, ft-in.	3-4½	3-2½	3-2½	2-5½	3-2½	3-2½
Working volume, tuyeres to stockline, cu ft	25,121	26,759	30,006	23,670	22,068	32,517
Bosh angle, deg-min	82-09	84-14	82-44	81-57	80-19	80-50
Inwall slope, in. per ft	¾	¾	1⅝-¾	¾	¾	1⅛
No. of tuyeres	14	10	16	10	12	16
Tuyere diameter, in.	6	6½	6	6½	6	6
No. of columns	7	10	8	10	12	8
Lining thickness, crucible, in.	36	40½	36	36	36	42
Lining thickness, bosh, in.	31½	33	31½	30	33	33
Lining thickness, stack, in.	45	40½	40½	45	49½	45
Lining thickness, throat, in.	36	31½	31½	40	48	30
Big bell diameter, ft-in.	13-0	13-9	14-0	12-6	12-6	14-0
Big bell angle, deg	52	52	52	52	52	52
Number of stoves	4	4	4	4	4	4
Stove diameter, ft	22	22	21	21	22	22
Stove height, ft	(3) 120 (1) 108	(3) 122 (1) 108	(3) 116 (1) 104	104	(3) 100 (1) 108	(2) 118 (2) 100
Checker openings, in.	(3) 2½x2½ (1) 6x6	(3) 3x3 (1) 2½x2½	(2) 3x3 (2) 2½x2½	(2) 3x3 (1) 4¼x4¼ (1) 5x5	(3) 3½x3½ (1) 5x5	(3) 2x2 (1) 2½x2½
Heating surface per stove, sq ft	(3) 121,548 (1) 61,000	(3) 165,890 (1) 107,692	(2) 111,588 (1) 115,500 (1) 114,091	(1) 117,625 (1) 112,495 (1) 101,594 (1) 60,500	(3) 85,000 (1) 103,000	(1) 185,430 (2) 152,751 (1) 119,710
Blast volume, cfm, average	55,000	55,000	65,000	55,000	52,000	67,000
Blast volume, cfm, maximum	62,000	63,000	70,000	60,000	57,000	70,000
Blast temperature, F, average	950	1000	900	1050	1000	1100
Blast temperature, F, maximum	1150	1300	1000	1200	1200	1300
Lb of ore per gross ton of iron	3503	3648	3793	3666	3785	3515
Lb of stone per gross ton of iron	799	747	858	810	845	862
Lb of coke (3 per cent moisture) per gross ton of iron	1944	1865	1876	1977	1989	1958
Lb of scrap charged per ton of iron	114	193	99	115	80	81
Lb of open hearth slag per ton of iron	163	141	145	149	137	162
Lb of roll scale per ton of iron	94	80	103	75	91	85
Daily iron production, gross tons, average	734	740	935	712	712	935
Daily iron production, gross tons, maximum	1006	1141	1185	942	978	1282
Lb of slag made per ton of iron	1017	965	1075	1136	1060	1036
Lb of flue dust made per ton of iron	141	266	177	185	98	201
Ratio, stone to mix, per cent	22.0	26.1	21.5	24.3	25.6	21.3
Fuel ratio	2.05	2.10	2.02	2.08	2.10	2.12
Silica in mix, per cent	8.27	8.47	9.36	10.54	8.80	8.31
Theoretical yield, per cent	92.50	92.30	92.80	92.10	93.20	93.20
Actual yield, per cent	94.31	91.89	93.61	93.06	93.29	93.18

The Eliza blast furnaces, with an annual capacity of 1,927,000 tons of iron, parallel the Penn-Lincoln parkway coming into Pittsburgh from the East.

The turboblowers are equipped with surface condensers and operate on 410 psi steam, each consuming about 75,000 lb of steam per hour. The blowing engines have jet condensers, and use about 40,000 lb per hour of 150 or 250-psi steam each.

Blast is preheated for each furnace by four two-pass, side-combustion hot blast stoves, details of which are given in Table IV. Checkwork in these stoves varies, with basket-weave design in the majority and several patented designs in the remainder. Blast furnace gas, cleaned to a dust content of 0.15 to 0.21 grains of dust per cu ft, is introduced through pressure type proportioning burners at a rate of 5500-8000 cfm. The stoves consume about 30 per cent of the gas made by the furnaces.

The stoves are normally operated on a seven-hour cycle, five hours on gas and two hours on blast. Flue gases leave the stoves at temperatures ranging 400-600 F. Blast temperatures to the furnaces are controlled at the desired point by automatic mixer valves. Blast pressures at the tuyeres average 19-21 psi. A blast conditioner on No. 6 furnace reduces moisture content of the blast to about three grains per cu ft.

On each furnace, gas leaves the top through four off-takes ranging 3 ft 9 in. to 4 ft 7½ in. in diameter inside the brick lining. Top temperatures run 250-550 F and top pressures, 25-60 oz per sq in. The four off-takes combine into two downcomers which lead to the dust catcher.

The blast furnace gas leaving the furnace top usually carries 3-15 grains of dust per cu ft, and has an average analysis about as follows:

	Per cent
CO_2	12.3
CO	25.4
H_2	1.4
CH_4	0.3
Illuminants	0.1
N_2	60.5

The gas has a net heating value of 90.5 Btu per cu ft and a specific gravity of 1.029.

All blast furnace gas is wet washed in tower washers to 0.12 to 0.18 grains of dust per cu ft. The gas to be used in the stoves then passes through two disintegrators, where the dust content is further reduced to 0.008 grains per cu ft. The surplus gas is used for steam generation, except for some 3500 to 6000 cfm which is cleaned to 0.005 grains per cu ft in a small electrostatic precipitator and taken to a gas-mixing station.

Water from the gas washers flows to three thickeners, where the dust settles out and the clear water is decanted from the top. One of these units is a 60-ft diameter single tray of 3700 gpm capacity, one a 35-ft diameter double tray of 1500 gpm capacity and the third, a 30-ft diameter triple tray of 1700 gpm capacity. Sludge is dewatered in filters and taken to the sintering plant.

Sludge from the thickeners and dry flue dust from the dust-catchers are sintered in a continuous pallet type sintering plant of 1550 net tons per day capacity. The machine has 14 wind boxes, each 5 ft 10 in. × 7 ft 4 in. Suction is provided by two 70,000 cfm, 26 in. water column fans.

Two types of basic iron are produced, a high man-

No. 4 open hearth shop, with eleven 275-ton furnaces, was put in operation in 1951.

ganese type for use in the open hearth furnaces and a medium manganese type for the ingot mold foundry. Analyses range about as follows:

	High manganese	Medium manganese
Silicon	0.80-1.10	0.90-1.20
Sulphur	0.04 max	0.04 max
Phosphorus	0.025 max	0.150 max
Manganese	1.25-1.75	0.50-0.80

Iron is cast from each furnace every 4 hr 48 min into mixer type ladles for transfer to the open hearths, foundry or pig machine. Two double-strand pig machines can put about 3000 tons per hour of iron into pigs, but are not regularly used, as practically all iron is used in molten form.

Slag, which ranges 965-1136 lb per ton of iron, has analyses generally falling within the following limits:

	Per cent
SiO_2	34.5-36.0
Al_2O_3	11.7-13.4
CaO	40.3-42.0
MgO	6.7- 8.0
S	1.7- 1.8
Fe	0.3- 0.5
Mn	0.5- 1.1

The slag is either granulated in pits adjacent to the furnace and then loaded into railroad cars, or carried in ladles to a central hot slag pit, where it is dumped and later handled by a commercial slag company. The total slag production is about evenly divided between these two methods of disposal.

OPEN HEARTH

All steel now produced in the Pittsburgh Works is made by the conventional scrap and iron open hearth process. An important part of the post-war rehabilitation program is the No. 4 open hearth shop, containing eleven 275-ton furnaces.

These furnaces are 85 ft 3 in. long × 24 ft 3 in. wide inside the steel work, and are spaced on 110-ft centers. Hearth dimensions are 57 ft × 18 ft, giving a hearth area of 1000 sq ft. Furnace bottoms are made up of a thin layer of insulating material next to the pan plates, followed by 18 in. of basic brick and 24 in. of rammed refractory. This gives a total bottom depth of 42 in., exclusive of the insulating layer.

The end slopes of the furnace pan plates are kept low so as to permit free expansion of the bottom material while heating up. Also, the lower slopes allow for a greater thickness of bottom material at the top of the wind box, where service conditions are severe.

Backwalls, with a slope of 8¼ in. in 12 in., are built of 18 in. of unburned chrome-magnesite brick above the sill level, thickening out below sill level, where it is also topped by a tapering layer of bottom material. Front walls are built of burned magnesite brick, 18 in. thick. Front piers above the sill line are of metal cased chrome magnesite brick 18 in. thick. The five charging doors are 61 in. wide and 60⅜ in. high.

The furnace roof, with a span of 21 ft 3 in. and a rise of 3 ft 2⅜ in., is 15 in. thick with 18 in. ribs every fifth row. Thicker sections along front and back skewbacks provide added protection in these hot spots.

The port ends are 16 ft 6 in. wide inside the steel work and have end and side walls of metal cased chrome-

magnesite brick varying in thickness from 13½ in. at the top to 22½ in. at the bottom. A single downtake 13 ft 6 in. ¼ 8 ft 10½ in. provides 119.8 sq ft at each end of the furnace. Port roofs are of silica brick.

Suspended construction with unburned chrome-magnesite brick 12 in. thick is used in the chill walls, fantail arches and fantail noses. The single slag pocket at each end of the furnace is 16 ft square and 13 ft deep.

Single regenerator chambers on each end, 32 ft 6 in. × 19 ft 6 in. inside, contain single-pass checkerwork to a depth of 16 ft 6 in. Checkerwork is designed with vertical flues 7½ in. × 7½ in., and totals 10,450 cu ft of volume on each end of the furnace. Regenerator roofs are of flat, suspended construction, 10 in. thick. Regenerator walls are 22½ in. thick, plus 1½ in. of insulation. The side walls of the slag pockets and roofs of the regenerators are also insulated. Provision has been made for blowing the checkerwork with steam.

Furnace binding consists of rolled slab buckstays, 15 in. × 6 in., along the front and back walls, and 15 in. I-beams on the port side walls and ends, all tied by heavy structural members. Skewbacks of the furnace are of cast steel. Furnace doors, door frames and front buckstays are water cooled.

The flue for each regenerator is 7 ft wide × 9 ft high, providing an area of 57.7 sq ft. Each flue contains an electrically operated water-cooled slide type reversing valve. Past these valves, the two flues merge into one which leads to a water-cooled sliding damper controlling the furnace draft and on to the stack. Soot blowers are installed from the bottom of the checker chambers through the flue systems to the base of the stacks to reduce the build-up of flue dust. Brick-line furnace stacks 250 ft high provide natural draft for the furnaces.

Water-cooled, double-barreled artillery type burners introduce residual tar or fuel oil and coke oven gas through the furnace ends. The upper barrel of the burner carries the steam-atomized liquid fuel, the lower barrel conducts the gas. Both barrels are of 4-in. pipe, forming a water jacket around the fuel pipes. Inside the 2½ in. gas pipe is a 1-in. pipe for the introduction of oxygen if desired. The center line of the upper barrel is 5 in. above that of the lower barrel at the outlet end. The burners will handle enough coke gas to make up about 30 per cent of the total fuel input, but the average gas use is about 18 per cent.

Air for combustion is supplied to each furnace by a 22,500 cfm fan.

Tar and fuel oil are supplied to the open hearth shop through two separate circulating systems operating at 225-psi pressure. Temperature of the liquid fuel is held at a point conducive to good pumping, and the temperature is raised to the desired point for atomizing by individual heaters at each furnace. The temperature is automatically controlled. Each circulating system is equipped with a pilot viscosity control unit. The readings of these units indicate the temperature setting for the individual heaters.

Fuel oil may be received by river barge, railroad tank cars or trucks, which are unloaded into storage tanks. Residual tar comes by tank cars, which are unloaded into tanks. On the south side of the river there are four 2,000,000-gal tanks, normally three for oil, one for tar. There are also two 1,000,000-gal tanks for residual tar at the by-product plant. In addition, consuming departments have their own smaller storage tanks. Fuel tanks and pumphouses are fully protected against fire by automatic extinguishing systems.

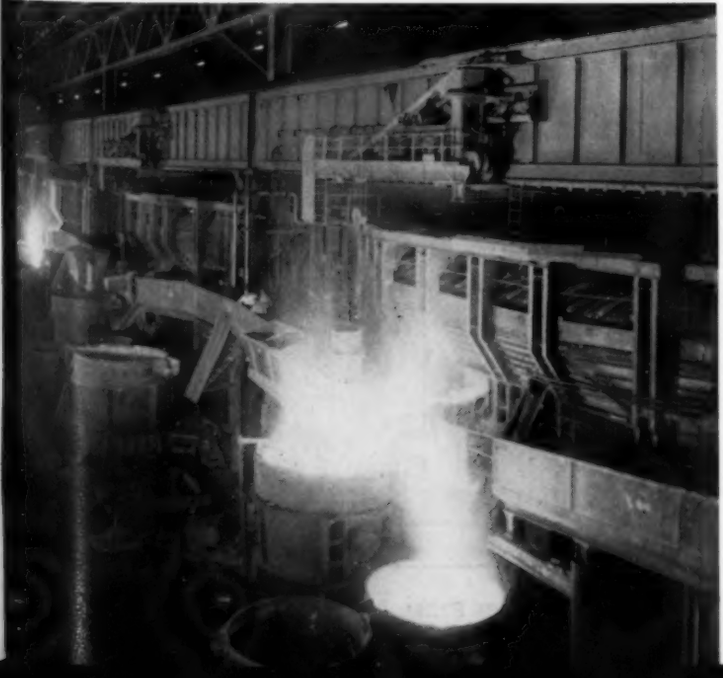
Each furnace is equipped with automatic controls on liquid fuel flow, gas flow, fuel-air ratio, furnace pressure, roof temperature, liquid fuel temperature, atomizing steam pressure, and furnace reversal. Instruments record the flow of total fuel and air, checker and stack temperatures, and bath temperature. Fuel flow is also integrated. All instruments and controls for each furnace are mounted on a panel board and console which forms part of the front wall of a two-story control house.

The furnaces are charged with scrap and hot metal in about equal proportions. Fuel is first introduced at the maximum rate of 95,000,000 Btu per hr, and reduced as required in the later stages of the heat. Heats are produced in approximately 12 hr, tap-to-tap, or about 22.5 tons per furnace hour. Fuel consumption averages 3,600,000 Btu per net ton of ingots.

Consumption of miscellaneous materials average as follows:

	Lb per net ton of ingots
Ore	
Charge	202.6
Feed	52.1
Fluxes	
Limestone	122.0
Burnt lime	41.4
Fluorspar	8.1
Ferro-alloys	
Ferro-manganese, medium carbon	2.3
Ferro-manganese, regular	14.3
Ferro-phosphorus	1.0
Silico-manganese	0.7
Speigel	2.5
Deoxidizers	
Aluminum	0.7
Ferro-silicon, 11 per cent	1.7
Ferro-silicon, 50 per cent	0.9
Ferro-silicon, 90 per cent	0.1

The pouring bay of No. 4 shop is 1430 ft long x 76 ft 6 in. wide and is served by four 350-ton ladle cranes.



Steel is produced in a wide variety of carbon and alloy grades (rim, mechanically capped, semi-rim, semi-killed, killed and fine grained killed), in analyses ranging as follows:

	Per cent
Carbon	0.04-1.05
Manganese	0.22-1.90
Phosphorus	Up to 0.15
Sulphur	Up to 0.33
Silicon	Up to 0.37
Chromium	Up to 1.10
Molybdenum	Up to 0.55
Vanadium	Up to 0.06
Copper	Up to 0.35
Aluminum	Up to 0.05
Nitrogen	Up to 0.015
Nickel	Residual only

Heats of 275 tons are tapped into ladles and poured into 25 in. × 27 in., 27 in. × 36 in., and 27 in. × 43 in. bottle top ingot molds, 27 in. × 52 in. and 25 in. × 47 in. big-end-up hot-topped molds, 29 in. diameter round molds, and 27 in. × 36 in., 27 in. × 43 in., 27 in. × 52 in., and 27 in. × 66 in. open top molds. Prior to pouring, molds are dipped in or sprayed with oil.

Slag made in the process averages about 35 tons per heat. The furnaces are designed for front and back flushing, with a cinder pot car running on tracks under the furnace hearth between the regenerators. The slag is transported to a slag dock where it is broken and sorted for metallics. It is then loaded into barges and carried to a disposal site.

Miscellaneous equipment includes a stopper rod press, stopper rod oven, coal dryer and dolomite machines.

No. 4 open hearth shop consists of six parallel and adjacent bays. A narrow lean-to contains overhead storage bins for limestone, burnt lime, dolomite, ore and sinter. The material is dumped from railroad cars on a track above the bins, and is discharged from the bins into buckets or charging boxes on cars running on a track beneath the bins. Adjacent to this bay is a wider lean-to containing three railroad tracks. Next come the charging floor, the pouring bay, the ingot run and mold yard.

Dimensions of these bays and their crane facilities are given in Table V.

Two older open hearth shops, known as No. 2-A and 2-B, are also located on the south side of the river. No. 2-A shop contains four 225-ton furnaces, with hearths 52 ft long × 15 ft 6 in. wide. No. 2-B shop has five 175-ton furnaces, with hearths 44 ft × 16 ft. Originally, all of these furnaces were of tilting design, and were built to operate on the Talbot process, wherein small quantities of molten iron were charged into the baths in the furnaces, along with oxidizing agents and fluxes. Steel was poured out of the furnace in small portions, keeping the greater part of the bath in the furnace to react with the next charge.

When the Talbot process was abandoned in 1924, the furnaces were used for duplexing, refining blown metal from the bessemer converters. This process also has been discontinued at this plant and the furnaces now operate on the conventional scrap and iron process. The four furnaces in No. 2-A shop have been rebuilt as stationary units, but the five in No. 2-B shop are still of tilting design.

BLOOMING AND BILLET MILLS

The Pittsburgh Works has two blooming mills, a 46-in. unit installed in 1952 and an older 44 in. unit.

The 46-in. mill is a high-lift, two-high reversing stand designed to roll slabs 27 to 62 in. wide and 4 to 6 in.

TABLE V

Buildings and Cranes — No. 4 Open Hearth Shop

	Length, ft-in.	Width, ft-in.	Cranes		Span, ft-in.
			No.	Capacity, tons	
Stockyard	880-0	70-9	3	10	66-0
			1	15/10	66-0
Leanto	1240-0	20-8	.....	.....	.....
Leanto	1430-0	60-0	.....	.....	.....
Charging floor	1430-0	85-6	4*	12	
			3	150/40/20	78-6
			3	25	10-0
			11†	10	
Pouring bay	1430-0	76-6	4	350/60/20	66-0
			4†	1	
Ingot run	1155-0	34-0	.....	.....	.....
Mold yard	715-0	88-0	2	25/10	83-3
			2	60/25	83-3
Cinder yard	357-6	88-0	.....	.....	.....
Stripper	307-6	82-0	2	400/25	75-6
Mixer building	210-0	85-6	1	60/25	78-6

*Charging machines †Jib cranes

TABLE VI

Buildings and Crane Data — No. 2 Open Hearth Shop

	Length, ft-in.	Width, ft-in.	Cranes		Span, ft-in.
			No.	Capacity, tons	
No. 2-A Stockyard	430-0	75-0	2	10	70-0
			1	20	70-0
No. 2-A Charging bay	465-0	66-6	2*	10	
			1	15	63-2½
			1	30/10	63-2½
			1	40/20	63-2½
No. 2-A Pouring bay	470-0	39-6	2	300/40	36-0
			1	125/30	36-0
			1	25/10	50-0
No. 2-A Hot top building	240-0	30-0	1	10	25-0
No. 2-B Charging bay	520-0	60-0	4**	10/30	57-9
			1	40/20	20-0
			1	15	57-9
		38-0			
No. 2-B Pouring bay	520-0	35-0	2	226/40	35-0
			1	75/30	35-0
No. 2-B Hot top building	155-0	35-0	1	5	26-0
No. 2 Mold yard	450-0	45-0	1	25	52-0
			1	10	52-0
			1	5	52-0
No. 2 Stripper yard	300-0	75-0	2	200/15	65-0
No. 2 Mixer building	130-0	75-0	1	60/30/10	69-6

*Charging machines **Overhead chargers

thick from ingots ranging from 27 in. × 36 in. (18,000 lb to 27 in. × 66 in. (41,400 lb). Housing posts have a minimum cross-sectional area of 500 sq in. The mill uses cast alloy steel rolls 45 in. in collar diameter and 114 in. body length, with necks 27 in. in diameter × 28 in. long running in babbitted bearings. The rolls carry edging passes of 8⅝ in., 5⅝ in. and 13 in., and a 69⅝ in. bullhead. The top roll, which is mechanically balanced by a counterweight, is moved up and down by 16 in. hardened steel screws of 2½-in. pitch, working in bronze screw boxes and driven through worm reducers by two 200-hp, d-c, mill type motors under adjustable voltage control. The mill is designed for a maximum roll opening of 66 in. and a maximum roll lift speed of 670 in. per min is available.

The 46-in. mill is driven by a twin drive consisting of two 5000-hp, 40/100-rpm, 700-volt, d-c single armature motors, each motor driving one roll through a 22-in. diameter spindle 34 ft 3 in. long. As the top roll in the mill moves between its top and bottom limits, the top spindle slope varies from an inclination of 6.25 per cent to a declination of 1.17 per cent.

The main drive has a rated full load torque of 1,312,000 lb-ft at speeds up to 40 rpm, and a maximum emergency torque of 3,610,000 lb-ft. The motors receive power from a motor-generator set composed of four 2500-kw, 700-volt, d-c generators and a 14 ft × 18¼ in., 142,300-lb steel plate flywheel, all driven by an 8000-hp, 13,800-volt, 3-phase, 60-cycle, 514-rpm wound rotor induction motor. At synchronous speed, this set has a stored energy of about 290,000 hp-sec.

The four generators and the two mill drive motors are connected in parallel on a common bus, with circuits so arranged that any one generator can be taken out of service without disturbing mill performance. Rotating regulators are used to make the two drive motors share the load equally and to balance the load between the generators.

The regulating system of the entire drive affords rapid mill reversal, it being possible to go from 40 rpm forward to 40 rpm reverse in one second, and from 80 rpm to 80 rpm in about three seconds.

The main drive motors, motor-generator sets, control and switchgear are housed in a motor-room provided with a down-draft recirculating ventilating system. Recirculated air is passed through spun glass filters and surface type coolers, while make-up air is cleaned by an electrostatic precipitator. The motor room is served by a 60-ton crane of 71 ft 9 in. span.

Main mill tables are of heavy construction, 42 ft 6 in. long with rollers 20 in. in diameter × 110 in. body length running in roller bearings. They are driven through line shafts by two 200-hp mill type motors on each table. Operating under adjustable voltage control, table speeds up to 267 fpm are available.

Scale falling through the tables is flushed into a scale sump, from where it is removed by a 1½ cu yd grab bucket and loaded into hopper cars.

Each of the four feed rollers of the mill is driven by a 150-hp, 230-volt mill type motor which is operated at 40 volts to give a rating of 17 hp at 53 rpm.

The manipulator is designed for very rapid operation, with a top sideguard speed of 158 fpm. The left and right sideguards are each driven by two 200-hp mill type

motors, and front and back manipulator fingers are each driven by a 150-hp motor, all under adjustable voltage control.

Power is provided for the various auxiliary drives by two motor-generator sets, each composed of four 200-kw, 250/600-volt generators and one 40-kw, 40/100-volt generator, all driven by a 900-hp motor. The pairs of motors for the table and sideguard drives are each connected in series across a 200-kw generator. The two screwdown motors are connected in sandwich series with two 200-kw generators. The two feed roll motors on each side of the mill are connected in parallel across a 40-kw generator. Manipulator finger motors are each fed by an individual 200-kw generator.

A stand-by generator, duplicating the 200-kw units of the foregoing sets, driven by a 300-hp motor, may be switched in to replace any one of the adjustable voltage generators that may be out of service.

As the slab moves from the mill stand, it passes under a radiation pyrometer which measures and records its temperature.

Located 147 ft 7½ in. beyond the mill is a 2500-ton up-cut hydraulic shear capable of cutting slab sections up to 1000 sq in. The shear is operated by a closed hydraulic system powered by two 205-gpm, 2500-psi pumps. Following the shear is a drop table which allows crop ends to fall through a chute to a flight conveyor which delivers them to a scrap car outside of the building. The shear gage, which is operated through a screw from a 50-hp motor, will measure lengths up to 21 ft.

Immediately following the shear is a scale where product may be weighed. Scale levers and drives are under the tables, and the electronic recorder is in the shear recorder's pulpit. Weights of slabs are recorded and totaled.

Two rack-and-pinion type pushers move slabs from the runout table on to two screw-driven elevator pilers. Piles up to 48 in. high are formed and dragged off to make room for other piles. The piles are then moved by crane and C-hooks either to slab rack cars, the stocking area or the conditioning yard.

The entire mill is lubricated by five automatic grease systems which serve some 750 points, and by one circulating oil system serving 10 points.

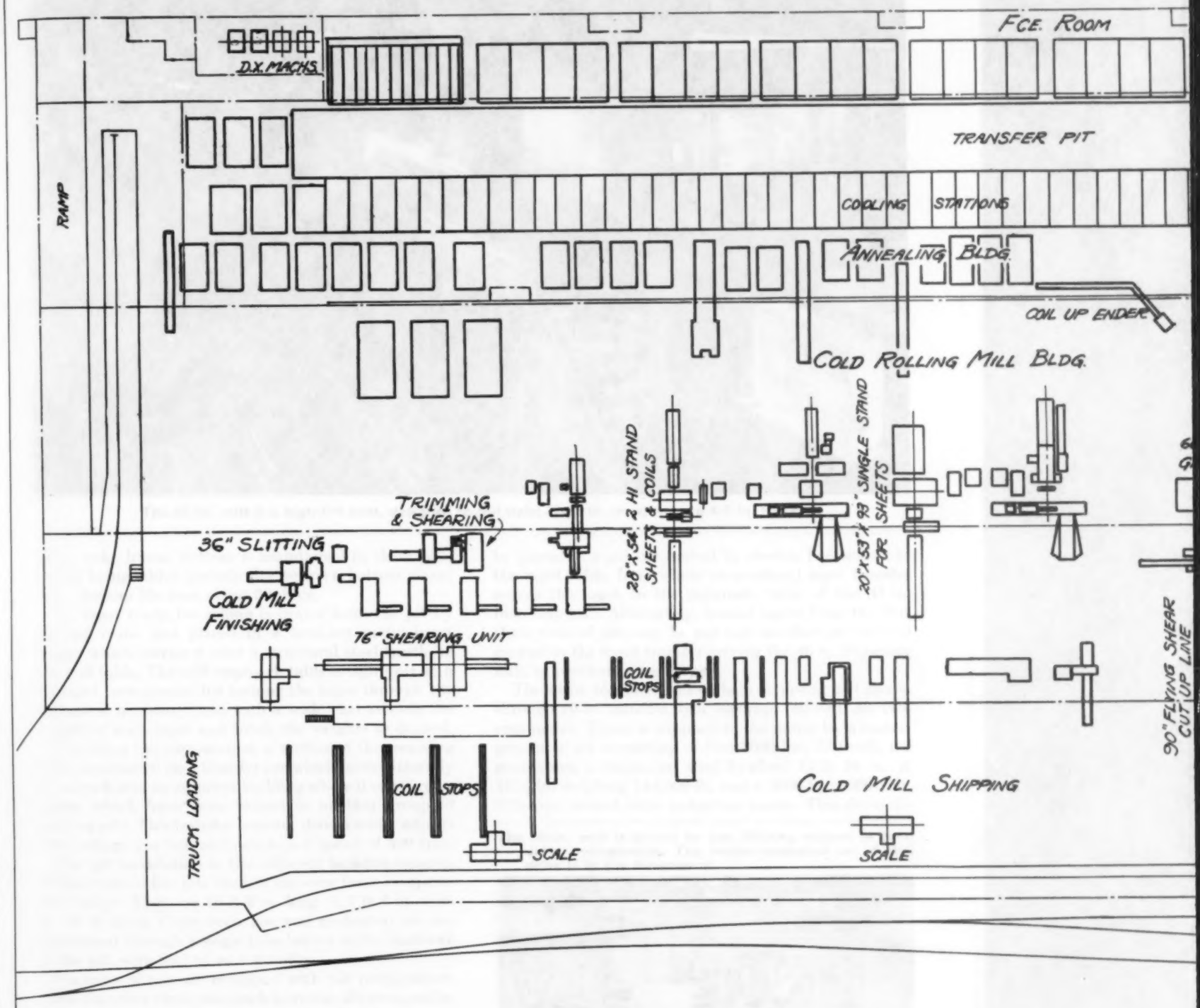
This mill rolls at speeds up to 1200 fpm and averages about 270 net tons per hr. It has rolled as much as 400 tons per hour, 2943 tons in one 8 hr turn, and 161,592 tons in a month. Power consumption averages 11.05 kwhr per net ton of product on the main drives and 5.11 kwhr per ton for auxiliary drives.

Preceding the 46-in. mill and in line with it are 12 recuperative soaking pits, 27 ft long × 9 ft 6 in. wide × 14 ft deep, fired with coke oven gas, with fuel oil as a standby. Gas and preheated air are introduced through a single multiple-tube burner in the back wall of each furnace. Fuel-air ratio is automatically controlled, as is pit temperature and furnace pressure.

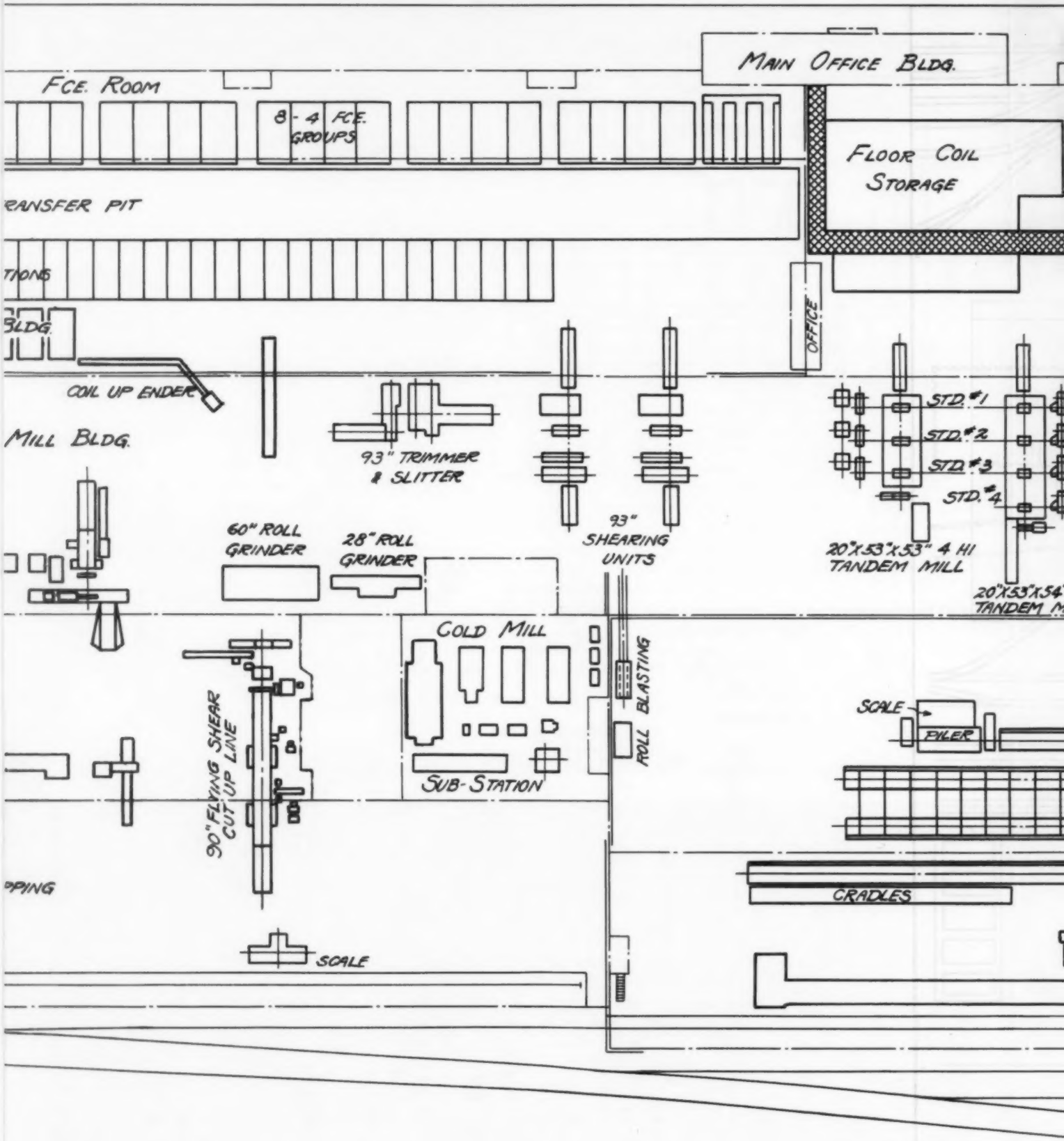
The pits are arranged in three rows of four pits each, with a refractory tile recuperator and a metallic recuperator in series for each row. Air for combustion is pushed through the recuperators by a 5400-cfm, 40-oz per sq in. fan for each row. The air attains temperatures averaging about 1050 F.

Two 25-ton pit cranes of 91 ft 8 in. span move ingots into and out of the pits. Normally, ingots are charged at temperatures of 1600-1800 F, with an average track time of about two hours. Heating time ranges from two hours for hot ingots up to 12 hours for cold ingots. Each pit will hold 125 tons of ingots. Fuel consumption averages 490,000 Btu per net ton of ingots heated. An

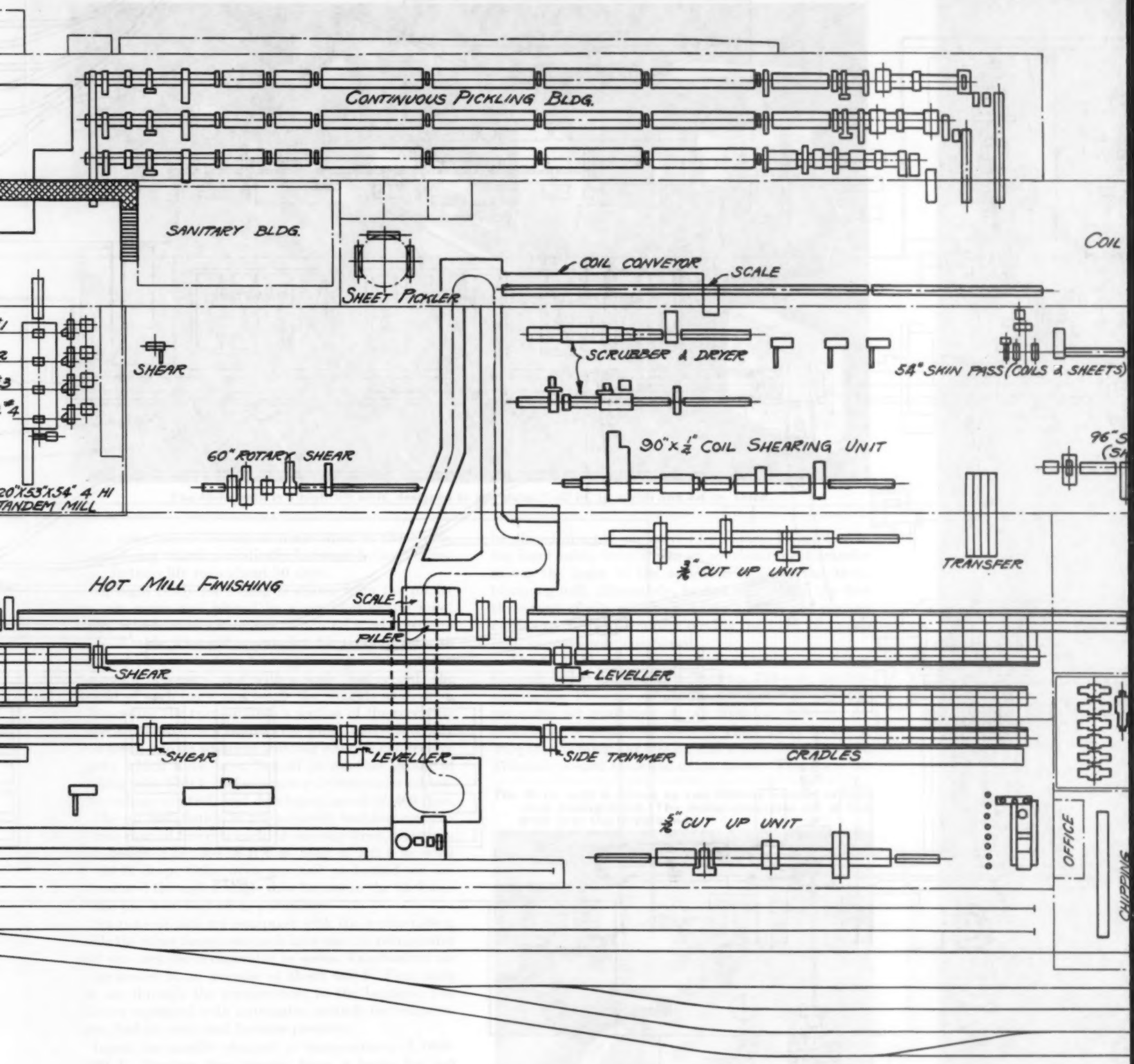
Soaking pits are of recuperative design, fired with coke oven gas (with fuel oil as standby) through a single burner in the backwall.


FCE. ROOM
D.X. MACHS.
TRANSFER PIT
RAMP
COOLING STATIONS
ANNEALING BLDG.
COIL UP ENDER
COLD ROLLING MILL BLDG.
TRIMMING & SHEARING
36" SLITTING
COLD MILL FINISHING
28"x54" 2 HI STAND SHEETS & COILS
20"x53"x93" SINGLE STAND FOR SHEETS
76" SHEARING UNIT
COIL STOPS
90" FLYING SHEAR CUT UP LINE
TRUCK LOADING
COIL STOPS
SCALE
COLD MILL SHIPPING
SCALE

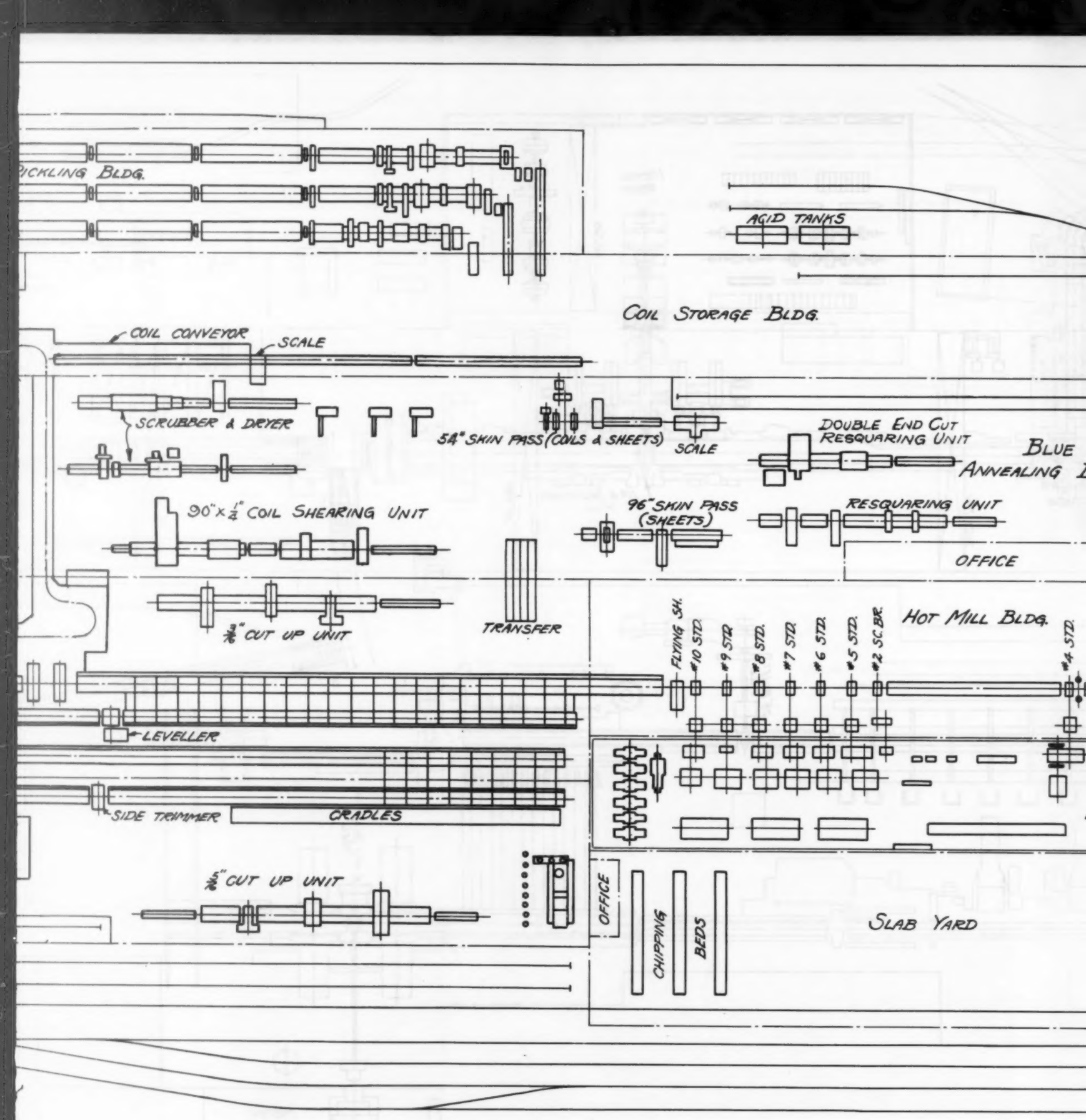
PLA



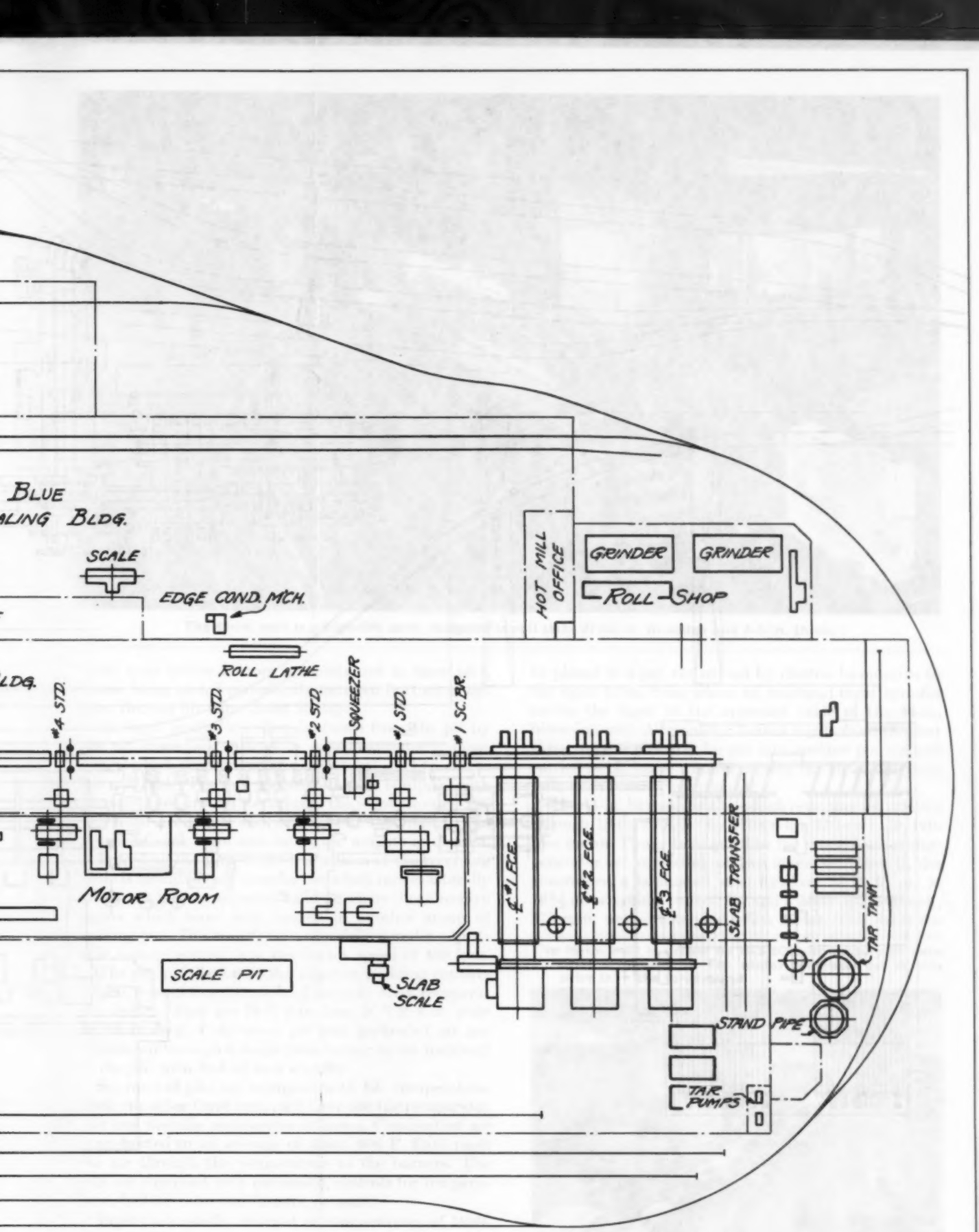
PLAN VIEW - HOT & COLD STRIP MILL



MILL - JONES AND LAUGHLIN STEEL CORP. - PITTSBURG



UGHLIN STEEL CORP.-PITTSBURGH WORKS


BLUE
ALING BLDG.
SCALE
EDGE COND. MCH.
ROLL LATHE
HOT MILL OFFICE
GRINDER
GRINDER
ROLL SHOP
#4 STD.
#3 STD.
#2 STD.
SQUEEZER
#1 STD.
#1 SC. BR.
MOTOR ROOM
SCALE PIT
SLAB SCALE
#1 EDGE.
#2 EDGE.
#3 EDGE
SLAB TRANSFER
TAR TANK
STAND PIPE
TAR PUMPS

PLAN VIEW - HOT & COLD STRIP

The 46-in. mill is a high-lift unit, designed to roll slabs 27-62 in. in width and 4-6 in. thick.

18-in. coke breeze bottom is maintained in these pits, breeze being added periodically between bottom cleanings. Bottom life runs about 30 days.

An ingot ready for rolling is drawn from the pit by the pit crane and placed in a semi-automatic ingot buggy which carries it over a structural steel trestle to the mill table. The mill approach table is equipped with an ingot turn-around for turning the ingot through 180 degrees if necessary, and with a scale that records the weight of each ingot and totals the weights as desired.

Preceding the turn-around, a section of the receiving table is mounted on a transfer car which moves laterally on a track into an adjacent building where it can receive ingots which have been heated in another group of soaking pits. This transfer is motor driven under adjustable voltage control, and develops a speed of 400 fpm.

The pit installation in the adjacent building consists of nine rows of five pits each, of one-way fired, recuperative design. They are 16 ft 6 in. long × 7 ft 2 in. wide × 13 ft deep. Coke oven gas and preheated air are introduced through a single tube burner in the backwall of the pit, with fuel oil as a standby.

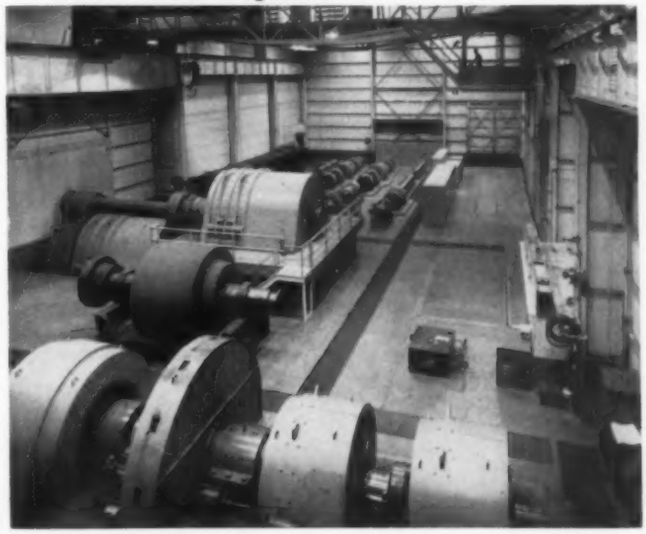
Six rows of pits are equipped with tile recuperators, while the other three rows each have one tile recuperator and one metallic recuperator in series. Combustion air is preheated to an average of about 600 F. Fans push the air through the recuperators to the burners. The pits are equipped with automatic controls for temperature, fuel-air ratio and furnace pressure.

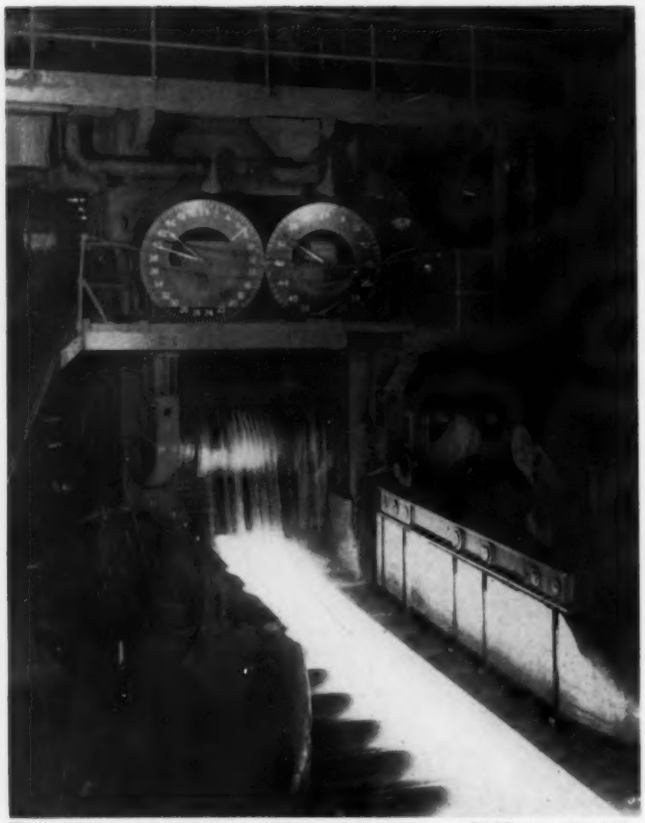
Ingots are usually charged at temperatures of 1600-1800 F. Heating time ranges from 4 hours for hot ingots to 13 hours for cold ingots. Fuel consumption averages about 700,000 Btu per net ton of ingots charged.

Four 15-ton pit cranes, of 92 ft 6 in. span, charge and draw ingots for this group of pits. The heated ingot may be placed in a pot car moved by electric locomotive to the ingot table, from where an overhead ingot transfer moves the ingot to the approach table of the 44-in. blooming mill. Alternately, heated ingots from the first three rows of pits may be put into another pot car and carried to the ingot transfer serving the 46 in. blooming mill, as previously mentioned.

The 44-in. bloomer is a two-high reversing mill driven through 19-in. spindles by a 7000-hp, 750-volt, 50/120-rpm motor. Power is supplied to the motor by a motor-generator set consisting of two 3000-kw, 750-volt, d-c generators, a laminated steel flywheel 15 ft 10 in. × 16½ in. weighing 142,000 lb, and a 5000-hp, 6600-volt, 375-rpm, wound rotor induction motor. This drive de-

The 46-in. mill is driven by two 5000-hp motors in twin drive arrangement. The motor-generator set of this drive is in the foreground.





The 44-in. blooming mill is driven by a 7000-hp, 50-120-rpm, 750-volt d-c motor. Sideguards and manipulator fingers are hydraulically operated.

velops full-load torques of 735,000 ft-lb at 50 rpm and 306,000 ft-lb at 120 rpm.

This mill employs alloy cast steel rolls of 42-in. collar diameter × 90 in. body length. The top roll is hydraulically balanced, and is moved by 12-in. screws of 2-in. pitch, driven by two 100-hp mill type motors under adjustable voltage control. A lifting speed of 500 in. per min and a maximum lift of 46½ in. are available.

Babbitted bearings are used for roll neck bearings and for pinion bearings. Pinions are 44 in. in diameter, 54 in. face, and 7.2753 in. circular pitch, with double helical cycloidal teeth.

Manipulators are hydraulically operated, with two 15½ in. diameter cylinders on the sideguards and a 10-in. cylinder on the fingers.

The 44-in. mill operates at speeds up to 1175 fpm, rolling ingots into blooms or slabs at an average rate of 190 net tons per hr. A rolling record of 2063 net tons in 8 hr has been attained, while monthly production has reached 132,936 net tons. Power consumption averages 15.22 kwhr for the main drive and 11.72 kwhr for the auxiliaries per net ton of product.

When rolling slabs, the product is moved over mill tables straight ahead to a 2000-ton hydraulic shear 184 ft beyond the mill. The shear can cut sections of hot steel up to 600 sq in. The shear gage is electrically operated. Crops are chuted down into buckets in a pit below the shear, lifted by crane and dumped into a railroad car.

From the shear, the slabs or blooms are moved to two hot beds, over which they are pushed to pilers and then handled by overhead crane.

When rolling blooms for further reduction, product leaving the 44-in. mill is moved laterally to the right over a bloom transfer to a parallel mill line containing a single-stand, three-high 28-in. billet mill, preceded by a hot scarfing machine. The billet mill is driven through 28 in. × 28½ in. 15-tooth pinions by a 42 in. × 76 in. × 60 in. tandem compound steam engine of 3500 hp, 79 rpm. The rolls are 28 in. in diameter × 64¾ in. body length. The mill has a rolling speed of 580 fpm.

Tilting tables on both sides of the mill raise and lower the blooms between the upper and lower pass lines. The tables are composed of grooved rollers driven through bevel gears and line shafts by 200 hp motors.

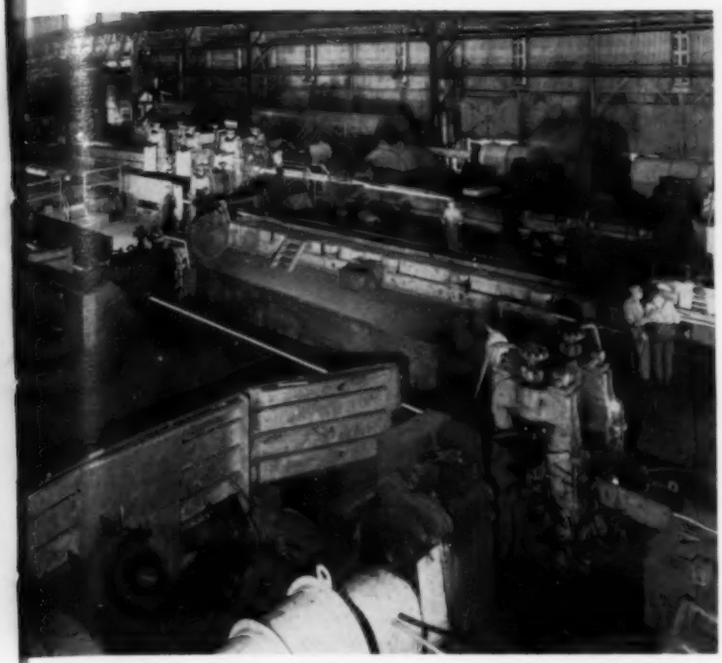
The 28-in. mill receives 8½ in. × 7 in. blooms from the 44-in. mill and reduces them to 4 in., 5 in., 6 in. or 7 in. squares at an average rate of 110 tons per hr. The mill has produced as much as 1000 tons in an 8-hr turn and 87,000 tons in a month.

Leaving the 28-in. mill, billets proceed over a run-out table. If the product is to be shipped, it leaves the run-out table toward the left and proceeds through a shear and over a hot bed to cradles. If further rolling is required, billets leave the billet mill runout table toward the right and are transferred to another parallel mill line containing an eight-stand 16-in. continuous billet mill. This mill was installed in 1893 and was rebuilt in 1942.

All stands of the 16-in. mill are driven through bevel gearing and line shaft by a 3000-hp, 80-rpm vertical cross-compound steam engine. Gearing is such as to give the following mill speeds:

Stand No.	Gear ratio	Roll rpm	Delivery speed, fpm
1	4.55	17.5	88.2
2	3.56	22.5	111.1
3	2.03	39.3	145.8
4	1.59	50.19	182.3
5	1.24	64.68	245.5
6	1.04	76.4	283.3
7	0.82	95.5	354.9
8	0.695	115.3	431.1

Blooms are desurfaced by passing through a hot scarfing machine before subsequent rolling in the billet mill.



The 14-in. mill consists of twelve stands and produces a variety of merchant bar shapes at an average rate of 60 tons per hr.

A crop shear is located ahead of the first mill stand, and a flying shear, capable of cutting 3-in. square billets, follows the last stand.

This mill receives 5-in. square billets from the 28-in. mill and reduces them to 2 in., 2½ in. or 3 in. squares. An average production rate of 55 tons per hr is maintained, with records of 550 tons for an 8-hr turn and 49,000 tons for one month.

Billets leaving the 16-in. mill are moved to two hot beds and over to cradles.

MERCHANT MILLS

Merchant mill facilities of the Pittsburgh Works consists of two modern bar mills, details of which are given in Table VII.

The 14-in. mill takes 4, 5, 6 or 7 in. square billets and produces $1\frac{1}{32}$ to $5\frac{1}{8}$ in. diameter rounds, 1 to $1\frac{1}{4}$ in. concrete reinforcing bar, $5\frac{9}{64}$ to $2\frac{1}{2}$ in. squares, $1\frac{1}{4}$ to $3\frac{3}{4}$ in. round-cornered squares, $1\frac{1}{32}$ to $2\frac{5}{16}$ in. hexagons, and nut steel flats from $1\frac{1}{4}$ in. × $\frac{5}{8}$ in. to $3\frac{1}{32}$ × $2\frac{1}{16}$ in., as well as special sections and die-rolled products. The mill maintains an average rolling rate of 60 tons per hr, with records of 1238 tons in one eight-hour turn and 44,125 tons in one month.

Billets 8 to 17 ft long are heated in two continuous double-fired furnaces with hearths 19 ft wide × 74 ft long. Coke oven gas, tar or fuel oil is used for fuel, with a consumption of 1,870,000 Btu per net ton heated Temperature, fuel-air ratio and furnace pressure are automatically controlled on both furnaces.

Billets are moved through the furnaces by pushers and are discharged from the sides of the furnaces by pushout bars and ejector pinch rolls.

The first six stands of this mill are driven by a 2500-hp, 100/200 rpm, 600-volt, shunt wound, d-c motor through spiral bevel gearing. The first four stands have pinions of 20-in. pinion diameter × 22½ in. face. Stands No. 5 and 6 have 16 in. diameter pinions of 20-in. face.

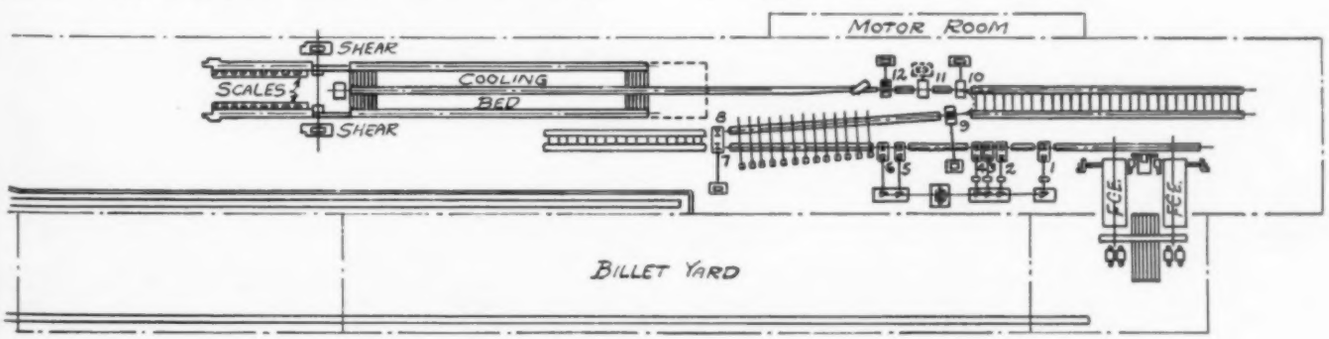
The first two finishing stands are driven by a 1250-hp, 100/200-rpm, 600-volt, d-c motor, and the last four stands are driven individually by 900-hp, 100/300-rpm, 600-volt, d-c motors. Finishing stand pinions are 14-in. pitch diameter × 17½-in. face.

All main drive motors receive power from a motor-generator set composed of three 2000-kw, 600-volt, d-c generators, a 125-kw, 250-volt, d-c exciter, and a 7000-hp, 6900-volt, 25-cycle, 500-rpm synchronous motor. Power consumption averages 24.22 kwhr for the main drives and 11.41 kwhr for auxiliaries per net ton of product.

Roll necks operate in fabric composition bearings, with babbitted bearings in mill drive gearing and pinion stands. Lubrication is provided by an automatic oil system.

Scale is removed from the steel by hydraulic sprays placed before stands No. 1, 6, 8, 9 and 10. Water at 1000-psi pressure is supplied by a 500-gpm centrifugal pump.

Bars leaving the mill move over the runout table to a double carry-over cooling bed 255 ft long × 40 ft wide. At each exit from the cooling bed is a shear capable of cutting sections up to 4 in. in diameter. Runout table rollers are driven at speeds matching the mill delivery speed by a variable frequency system operating from a 50/125-kva, 74/296-volt, 8.4/33.6-cycle generator.



Layout of 14-in. merchant mill.

The 10-in. bar mill, which was put into operation in 1953, consists of 16 stands in continuous layout, with a repeater between stands No. 9 and 10, and another between stands No. 12 and 13. These repeaters are mounted on wheels and may be moved so as to repeat from No. 8 to No. 10, from No. 8 to No. 11, or from No. 11 to No. 14.

The 10-in. mill, with sixteen stands, delivers small merchant bar sections at rates up to 3000 fpm.

Billets 2, 2½ or 3-in. square are reduced to $\frac{19}{64}$ to 1¼ in. diameter rounds, $\frac{19}{32}$ to $1\frac{3}{16}$ in. hexagons, $\frac{9}{32}$ to $1\frac{3}{32}$ in. squares, ⅜ to 1 in. concrete reinforcing bar, ¾ to 1½ in. angles, and flats from ⅝ in. × $\frac{3}{16}$ in. to 2½ in. × ½ in. The mill rolls at an average rate of about 40 tons per hr.

Billets 24 to 30 ft long are heated in a continuous end-charge, side discharge furnace with a 63 ft × 33 ft hearth, fired with coke oven gas, tar or fuel oil. The furnace is equipped with automatic controls for temperature, fuel-air ratio and furnace pressure, and fuel consumption averages 1,700,000 Btu per net ton heated. The furnace is rated at 90 tons per hr.

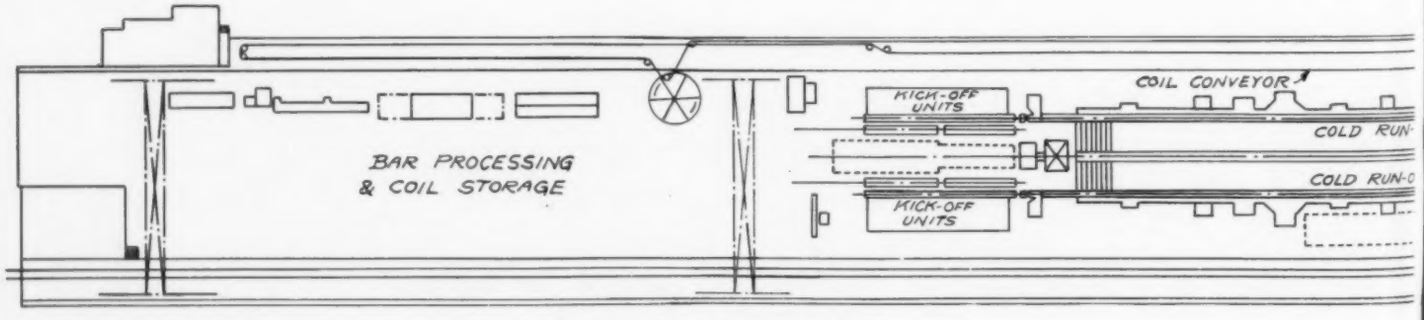
A pusher mechanism moves billets through the furnace, and they are discharged from the furnace by an ejector bar and pinch rolls directly on to the mill table.

The eight roughing stands of this mill are driven in pairs by four motors, while the last eight stands are individually driven. Details of these drives are given in Table VII. All of the motors are 600-volt, d-c, shunt wound units which draw power from a motor-generator set consisting of three 2250-kw, 600-volt, d-c generators, one 75-kw, 250-volt exciter and a 9500-hp, 514-rpm, 13,200-volt, 60-cycle synchronous motor.

The mill rolls operate in fabric composition bearings, and the top roll is adjusted by manually operated screws. The horizontal roll stands are driven through single helical gearing and pinions, the two vertical stands through spiral bevel gears and single helical pinions.

Just ahead of the mill is an up-cut shear for cropping or dividing the billet. A flying crop shear is located at the exit of No. 8 stand, and a rotary flying shear is provided at the exit of No. 16 stand. Also near the exit of No. 16 stand are three pouring reels which form coils of 34-in. inside diameter, 51-in. outside diameter, and 900-lb maximum weight. The rotary flying shear and pouring reels are driven from special motor-generator sets under adjustable voltage control.

Descaling is effected by hydraulic sprays at the entry of No. 1 stand. Water is furnished at 1300-psi pressure by a 250-gpm centrifugal pump.



Layout of 10-in. merchant mill.

TABLE VII

Merchant Mill Data

Stand	Roll size, in.		Distance from preceding stand, ft-in.	Motor hp	Motor rpm	Gear ratio	Roll rpm	Roll speed, fpm
	Maximum	Body length						
14-in. Mill								
No. 1 Rougher	22	40	.....			4.375	22.9/45.8	132/264
No. 2 Rougher	22	40	35-0			3.428	29.1/58.2	167/334
No. 3 Rougher	22	40	10-0			2.628	38.05/76.10	219/438
No. 4 Rougher	22	40	10-0	2500	100/200	1.974	50.7/101.4	292/584
No. 5 Rougher	17½	36	65-0			1.488	67.2/134.4	308/616
No. 6 Rougher	17½	36	10-0			1.18	74.8/169.6	388/776
No. 7 Finisher	15	24	124-0				100/200	393/786
No. 8 Finisher	16	24	.....	1250	100/200	Direct	100/200	419/838
No. 9 Finisher	16	24	180-0	900	100/300	Direct	100/300	419/1257
No. 10 Finisher	16	24	.....	900	100/300	Direct	100/300	419/1257
No. 11 Edger	15½	24	30-0	900	100/300	Direct	100/300	406/1218
No. 12 Finisher	16	24	32-0	900	100/300	Direct	100/300	419/1257
10-in. Mill								
No. 1 Rougher	17	36	.....			9.35	18.2/56.1	70/217
No. 2 Rougher	17	36	7-0	600	175/525	7.31	23.9/71.8	92/275
No. 3 Rougher	16	36	6-6			8.47	35.4/106.2	131/393
No. 4 Rougher	16	36	6-6	800	300/900	6.59	45.5/136.8	166/498
No. 5 Rougher	16	36	6-6			5.086	59/177	222/666
No. 6 Rougher	16	36	6-6	800	300/900	3.95	76/227.9	282/846
No. 7 Rougher	16	36	6-6			4.09	73.3/220	278/835
No. 8 Rougher	16	38	6-6	800	300/900	3.18	94.3/282.9	355/1065
No. 9 Intermediate	13	26	25-6	600	175/525	Direct	175/525	534/1062
No. 10 Intermediate	13	26	.....	600	250/625	1.487	168/420	505/1266
No. 11 Intermediate	13	26	18-6	700	250/625	Direct	250/625	767/1917
No. 12 Intermediate	13	26	24-0	600	250/625	1.116	224/560	681/1702
No. 13 Vertical Finisher	12½	20	.....	1000	350/875	1.229	285/712	860/2150
No. 14 Finisher	11¼	20	16-0	1000	350/875	Direct	350/875	931/2329
No. 15 Vertical Finisher	12½	20	15-0	700	450/1070	1.229	366/871	1109/2636
No. 16 Finisher	11¼	20	16-0	800	500/1150	Direct	500/1150	1302/3000

Product leaving the mill goes either to the pouring reels, from where a drag conveyor and hook conveyor carry the coils to an unloading station, or over the runout table to a double cooling bed 367 ft long × 35 ft 10 in. wide. A vertical cold shear is provided at each of the two exits from the hot bed. The runout table is operated at various speeds by a variable frequency drive system.

The mill and auxiliaries are lubricated by two circulating oil systems, four automatic oiling systems, and four automatic grease systems.

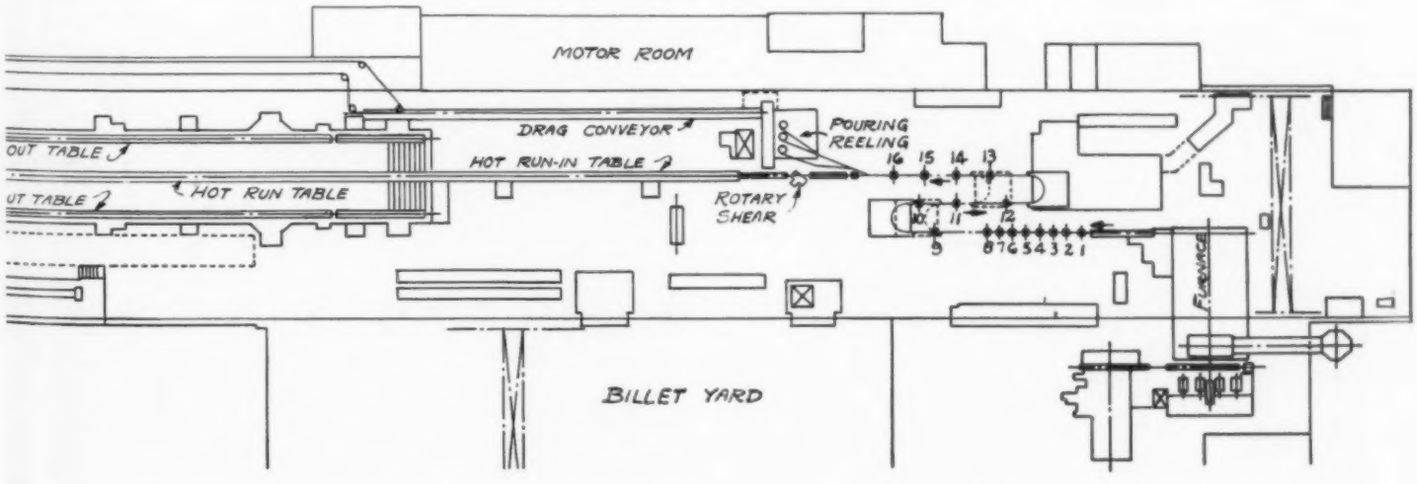
At the outlets of both bar mills are facilities for straightening, reshearing, bundling and shipping the product.

MISCELLANEOUS PRODUCTION DEPARTMENTS

Further processing of bar mill products is carried on at two locations, one on the south side of the river, with a monthly capacity of 18,085 net tons, the other on the north side of the river near the bar mills, with capacity for 16,210 net tons per month.

Cold drawn bars are produced by 13 chain draw benches with pull capacities of 61,600 to 197,500 lb, driven by motors ranging 50 to 150 hp in size. The product includes 11/16 to 3¾ in. rounds, 9/16 to 3 in. hexagons, 7/16 to 4 in. squares, flats from 9/16 in. × ½ in. to 6 in. × 2½ in. Production averages 44.6 tons per hour.

Smaller sizes are processed from coil stock by 13



The Pittsburgh Works has complete facilities for cold finishing bar products, including cold drawing, straightening, grinding, etc.

motor-driven drawing drums and straighteners at a rate of about 7.5 tons per hour. These products include $\frac{1}{8}$ to $\frac{1}{2}$ in. squares, flats from $\frac{3}{16}$ in. × $\frac{1}{8}$ in. to $\frac{1}{2}$ in. × $\frac{7}{16}$ in., and special sections.

Two motor-driven cold mills process flats 4 to 14 in. wide and $\frac{3}{16}$ in. and up thick, and cutter bars 5 to 7.5 ft long.

Four motor-driven turning machines process rounds of $1\frac{5}{16}$ to $6\frac{1}{8}$ in. diameter at an average rate of 4.4 net tons per operating hour.

Auxiliary equipment installed in the cold finishing departments includes various types of straighteners, shears, cold saws, chamfering and cut-off machines, centerless grinders, milling machines, torch cutting machines, planers, twisting machines, buffing machines, etc.

Heat treating facilities are also available, and include a radiant tube furnace for coils, four strain drawing furnaces for bars, one controlled atmosphere furnace for bars, and one induction heat treating furnace for $\frac{1}{2}$ to 2 in. round and hexagon bars.

There is also a heat treating unit used for quenching and drawing or normalizing bars 1 to 5 in. or plates $\frac{3}{16}$ to 2 in. thick up to 75 in. wide, in lengths up to 20 ft. This unit contains a heating furnace 60 ft long × 6 ft wide and a recirculating draw furnace 80 ft long × 6 ft wide. Both furnaces are of roller hearth design and are fired with natural gas or coke oven gas. Rollers in the heating furnace are $5\frac{1}{2}$ in. in diameter, and in the draw furnace, 3 in. in diameter. All rollers are spaced on $9\frac{3}{4}$ in. centers and driven by chains with variable speed reducers.

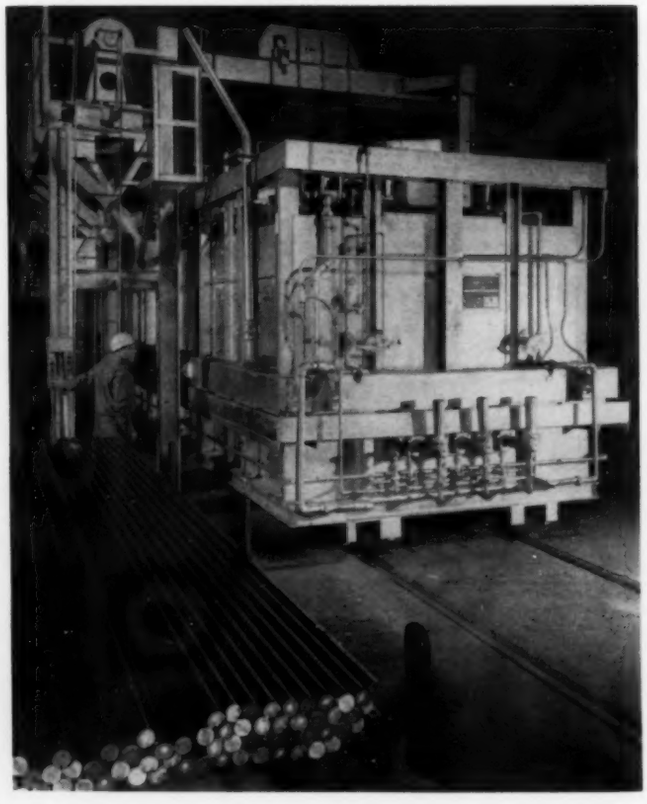
The heating furnace operates at temperatures up to 1650 F, the draw furnace up to 1200 F.

Spray quenching heads are located at the exits of both furnaces. Water for quenching is recirculated by two centrifugal pumps, one of 600-gpm and one of 525-gpm capacity, 100-ft head. Each quenching station is 21 ft 6 in. long. Conveyor tables handle the steel into and out of the furnaces. Steel is brought to the unit by overhead cranes.

The spike factory produces about 3000 tons per month of railroad spikes ranging from $2\frac{1}{2}$ in. × $\frac{3}{8}$ in. up to $6\frac{1}{2}$ in. × $\frac{5}{8}$ in. Bars $\frac{25}{64}$ to $\frac{21}{32}$ in. square and 27.5 to 30 ft long are heated in 33 ft × 32 in. gas-fired furnaces and conveyed to seven spike machines of various sizes.

The spikes, as they leave the machines, fall on to a

This bell type controlled atmosphere furnace is used for heat treating bar stock.



conveyor on which they are cooled before being delivered to an inspection and packaging station. Here they are packed into wooden kegs or steel containers for shipment.

There is also a department where concrete reinforcing bar stock is bent into various shapes as may be required for specific uses. The shop processes about 2000 tons per month, and contains various machines for shaping bar stock into stirrups, circles, spirals, etc., as desired.

STRIP MILLS

In 1937 operations began on a 96-in. continuous hot strip mill and attendant cold finishing equipment. These facilities occupy approximately 23 acres on the north side of the river, adjacent to the blast furnaces.

Slabs from the blooming mills are brought across the river on railroad cars of special design to a slab storage yard 100 ft wide × 650 ft long. Overhead cranes unload and stock slabs, and also move the slabs from storage to a magazine feeder, from which the slabs are fed, one at a time, on to a charging table 112 ft long which runs across the charging ends of the slab heating furnace.

Slabs are heated in three continuous, three-zoned furnaces of 94 ft 8⅝ in. overall length, with hearths 80-ft long × 18-ft wide. In the 63-ft main heating zone, which is overfired through six burners and underfired through eight burners, the slabs move over water-cooled skid pipes supported on refractory piers. The 17-ft soaking zone has a solid refractory hearth and is overfired through eight burners. The furnaces have flat suspended arch roofs and are completely insulated and steel encased.

Each furnace has capacity to heat 100 net tons of slabs per hour, and is fired with tar or coke oven gas. Either fuel may be used in the heating zone, but only gas is used in the soaking zone. Actually, the fuel averages about 76 per cent gas and 24 per cent tar.

Each zone of each furnace is equipped with one fuel-air ratio control and two fuel input controls. Each furnace also has two temperature controls and a furnace pressure control. Temperatures of the fuel tar and preheated combustion air are also automatically controlled. The air for combustion, which is pushed through a refractory tile recuperator by a 65,000 cfm fan, is preheated 425 to 475 F.

Slabs, in single or double row, are moved through each furnace by a double arm pusher driven by two 50-hp motors. Through the action of the pusher, a heated slab is expelled from the furnace on to the mill approach table, which is about 118 ft long and sectionalized into three units, each driven through line shaft by a 50-hp motor.

The hot strip mill is a 96-in. unit of conventional design, with a roughing scalebreaker, four four-high roughing stands, a finishing scalebreaker, and six four-high finishing stands. Details of these stands and their drives are given in Table VIII.

The first rougher is a broadside stand, in which slabs up to 90 in. long may be turned through 90 degrees and cross-rolled, thus increasing slab width beyond that obtainable from the blooming mills. To position the slab for cross-rolling, a turntable is installed on each side of the stand. Turntables are lifted hydraulically and turned by 7½-hp motors. To insure proper entry of the slab into the broadside stand, a slab pusher, driven by a 150-hp motor, is provided.

Following the broadside stand, there is a slab squeez-

Three continuous, triple-zoned furnaces, each of 100 tons per hr capacity, heat slabs for the hot strip mill.

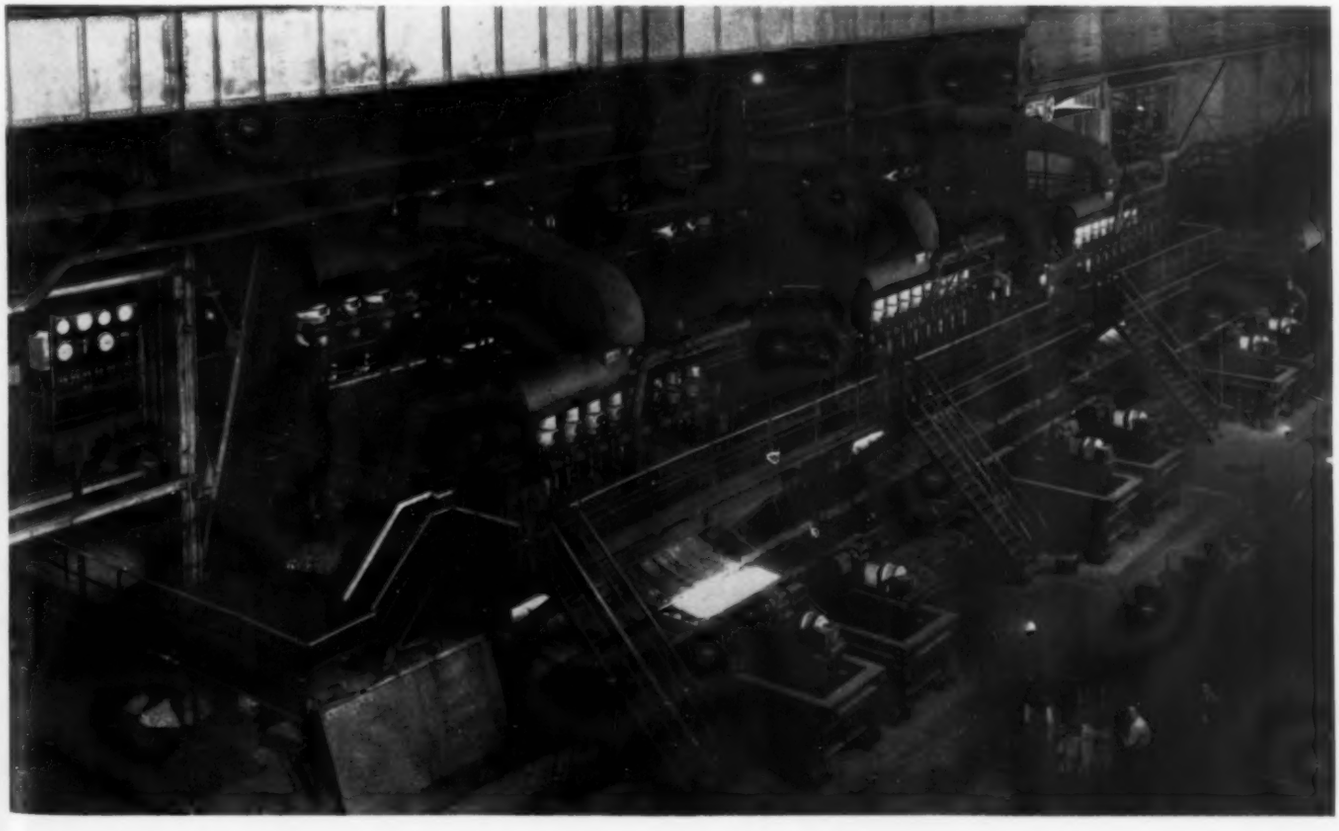


TABLE VIII

Strip Mill Data

Stand	Work roll		Back-up roll		Distance from preceding stand, ft-in.	Motor data				Gear ratio	Roll rpm	Roll face speed, fpm
	Diameter, in.	Body length, in.	Diameter, in.	Body length, in.		Hp	Voltage	Type	Rpm			
Hot Mill												
No. 1 Scalebreaker	24	76				1000	6600	*WR	375	8.81	42.57	267.9
No. 1 Rougher	38	96	51	90	31-4	3000	6600	*WR	150	7.846	19.11	190.5
No. 2 Rougher	28	96	51	90	44-3	3000	6600	*WR	375	7.8	48.8	351.8
No. 3 Rougher	27	96	53	90	52-6	3000	6600	*WR	500	7.8	64.1	453
No. 4 Rougher	27	96	53	90	82-6	3000	6600	*WR	500	7.8	64.1	453
No. 2 Scalebreaker	25½	94			110-11	500	600	†D-C	150/600	8.81	17/68	114/455
No. 5 Finisher	27	96	53	90	14-8	4500	600	†D-C	125/250	3.783	33/66	234/468
No. 6 Finisher	27	96	53	90	18-0	4500	600	†D-C	125/250	2.261	55.8/110.6	391/782
No. 7 Finisher	27	96	53	90	18-0	4500	600	†D-C	125/250	1.551	80.6/161.2	570/1140
No. 8 Finisher	27	96	53	90	18-0	4500	600	†D-C	125/250	1.193	104.8/209.6	741/1482
No. 9 Finisher	27	96	53	90	18-0	4500	600	†D-C	125/250	Direct	125/250	884/1768
No. 10 Finisher	27	96	53	90	18-0	3000	600	†D-C	175/350	1.193	146.7/293.4	1037/2074
Temper mill—Hot mill												
Single stand	28	55				250	250	D-C	500/1000	12.19	41/82	301/602
Reel							125	D-C	225/900	10.1	22.3/89	
Single stand	32	96				300	440	Ind.	300	12.19	24.6	206
Tandem cold mill												
No. 1 Stand	20½	54	53	51		800	600	D-C	250/750	6.92	36.1/108.5	194/582
No. 2 Stand	20½	54	53	51	16-0	1500	600	D-C	300/600	5.44	55.2/110.4	296/592
No. 3 Stand	20½	54	53	51	16-0	1500	600	D-C	300/600	4.15	72.3/144.6	388/776
No. 4 Stand	20½	54	53	51	16-0	1500	600	D-C	300/600	2.74	109.5/219	588/1176
Tandem cold mill												
No. 1 Stand	20½	93	53	90		1500	600	D-C	300/600	5.43	55.2/110.4	295/590
No. 2 Stand	20½	93	53	90	16-0	(2) 1500	600	D-C	300/600	4.15	72.3/145	388/778
No. 3 Stand	20½	93	53	90	16-0	(2) 1500	600	D-C	300/600	3.48	86.2/172	462/925
Temper mills—Cold mill												
Single stand	20½	93	53	90		800	600	D-C	250/750	4.15	60.2/180.6	323/969
Single stand	20½	93	53	90		250	250	D-C	225/450	8.81	25.5/51.0	137/274
Single stand	20½	93	54	90		1500	600	D-C	100/300	Direct	100/300	537/1610
Single stand	28	55				250	600	D-C	500/1000	12.19	41/82	301/602

*Wound rotor †D-c shunt

er, operated by a 265-hp motor. This unit squares up the slab to the desired width, and flattens it.

The next three roughers are equipped with vertical edging rolls 11 in. long × 22 in. in diameter, integral with the mill stands, each driven by a 150/187½-hp, 450/900-rpm, 230-volt, d-c motor mounted on top of the mill housing. These motors are geared to give edging roll speeds of 38.8 to 77.6 rpm. A pusher is also provided on No. 2 rougher to assist entry of the slab between the rolls. All roughing stands are so spaced that the slab is in only one stand at a time.

Leaving the roughing train, the steel passes over a roller table 110 ft 11 in. long which leads to the finishing train. These stands are closely spaced, so that the strip is in all stands at one time. Five loopers are installed, one behind each of the first five stands, to take up any slack in the strip as it passes through the stands. Each looper is driven by a 50-hp, d-c motor with manual control. Guides are also provided between the finishing stands to insure proper entry and delivery at each stand.

On each scalebreaker, the screwdown mechanism is driven by a 15-hp, d-c motor, while on the other mill stands, the screwdowns are driven by two 75-hp, d-c motors. The two motors may be hooked together through a magnetic clutch, so that the two mill screws may be operated in unison or separately, as may be necessary to get the proper roll setting.

All bearings on the back-up rolls of the hot mill are of the oil-flooded type. Babbitted bearings are used in both scale breakers and on the work rolls of the broadside stand. All other work rolls operate in roller bearings. Edger rolls work in bronze bushings.

Hydraulic sprays for descaling and cleaning the strip as it passes through the mill are located on the delivery side of both scalebreakers and all four roughing stands. Water for these sprays comes from two centrifugal pumps rated at 1000-gpm, 1400-psi pressure. Steam jets are also placed at each mill stand for blowing loose scale off the strip.

Preceding the finishing train is a crop shear which trims off the front end of the steel to facilitate its entry into the finishing stands. Immediately following the finishing train is a flying shear designed to cut hot-rolled strip up to 91½ in. wide × 5/16 in. thick into lengths of 15 to 32 ft. The shear is driven by two 150-hp motors, synchronized to the speed of the last finishing stand.

Located about 370 ft beyond the last finishing stand are two coilers, each driven by five 15-hp variable frequency, a-c motors which are synchronized with the mill runout table. Coils may be formed of 24-in. inside diameter, 44-in. maximum diameter, and 91½ in. maximum width. Air operated pushers remove coils from the coiler mandrels and a chain conveyor carries them to the coil storage building.

The runout table is equipped with individually driven rollers, controlled through variable frequency and voltage.

This view shows the 38-in. and 51-in. x 96-in. broadside stand in the background, followed by the slab squeezer and the second roughing stand.

Three circulating oil systems and seven grease systems provide lubrication for the hot mill.

The hot mill motor room, lying between the slab yard and hot mill building, contains the main mill drives with their reduction gears, control equipment and switchgear, as well as motor-generator sets. The roughing stand drives are controlled by liquid slip regulators. Finishing stand drives, operating under adjustable voltage, receive power from three motor-generator sets, each consisting of two 3000-kw, 600-volt, d-c generators driven by an 8400-hp, 375-rpm, 6600-volt, 25-cycle synchronous motor. The motors driving the five 150-kw variable frequency sets used on the coilers and runout tables also draw power from the main driver generators. A separate 500-kw motor-generator set supplies power for the flying shear.

Auxiliary d-c power is furnished by two 1500-kw motor-generator sets, and a 3000-kva bank of transformers, 6600/440/220 volts, provides auxiliary a-c power.

Rotating machinery in the motor-room is cooled by air forced from the room down through the units, through fin-tube surface coolers and air filters, and back into the room. Make-up air for the closed ventilating system is drawn through two air filters.

The hot mill reduces slabs ranging 20 to 62 in. in width, 4 to 6 in. in thickness and 60 to 190 in. in length down to strip running from No. 18 gage to $\frac{3}{16}$ in. in thickness. No. 18 gage can be produced in widths up to 48 in., No. 16 gage up to 60 in., No. 14 gage up to 72 in., No. 12 gage up to 90 in., and $\frac{3}{16}$ in. thick up to 93 in. wide.

The mill averages 200 tons per hour, and has produced as much as 1680 tons in an 8-hour turn and 148,511 tons per month.

Hot rolled product that is cut to length by the flying shear proceeds over the runout table past the coilers, and if of comparatively light gage, is carried to a piler at the end of the runout table. Overhead cranes handle the piles of sheets from the piler. When heavy gages are rolled, requiring longer cooling time, the material is moved laterally by chain-type transfers to three parallel table lines to the left of the mill. The first line contains a 17-roll leveler and a shear for plate up to 96 in. × $\frac{1}{2}$ in. The third line contains a rotary side-trimming and slitting shear, a 17-roll leveler and a plate shear, all for plate up to $\frac{1}{2}$ in. thick. At both ends of the final table there are roll-off skids, over which the plates are moved to cradles.

The plate finishing department also includes a trimming line for $\frac{5}{16}$-in. plate, a similar line for $\frac{1}{2}$-in. plate, a $\frac{1}{2}$ in. × 156-in. squaring shear, and a 135-in. circle shear. Plate shipping is done directly from this department.

Hot rolled finishing operations are carried out by a complete installation of equipment designed for cut lengths up to 90 in. wide, $\frac{3}{16}$ in. thick, and 22 ft long for black sheet or 18 ft for pickled sheet. Included in this department, which is located in an adjacent building to the right of the mill, are two 96-in. × $\frac{3}{16}$-in. side-trimming and shearing lines (one for coils, one for sheet), a four-arm vertical plunger mast batch pickler with a scrubbing and drying unit, a 60-in. shear and leveler line, a 90-in. shear and leveler line, a 60-in. circle shear, and various other shearing and squaring units.

There are also two single stand two-high temper mills, details of which are given in Table VIII. The 55-in. mill is equipped with an uncoiler and a tension reel, so that coiled material up to No. 12 gage may be processed as well as sheets. The 96-in. mill is equipped only with conveyor tables for sheet handling.

Coiled material which is intended to be cold reduced is taken from the coil storage building by overhead crane and conveyors, and delivered to the adjacent pickling department which contains two continuous units. The entry end of each line includes an uncoiler, a processing or scale cracking unit, a shear for trimming coil ends, a stitcher and welder, a looping pit and pinch rolls.

The last three roughing stands are equipped with vertical edging rolls, integral with the mill stands.

To form a continuous strand of material through the pickling tanks, coil ends may be lapped and stitched together mechanically, or butted and flash-welded, as desired. The looping pit provides storage for a considerable length of strip, so that travel through the pickling tanks is continuous during stops of the entry end for fastening the strips together.

One line contains four acid tanks, followed by a cold water tank and a hot water tank. The other line contains five acid tanks followed by a cold rinse and hot scrubbing machine. All tanks are constructed of welded steel plate, lined with ¼ in. thickness of rubber and an inner liner of acid-resisting brick. The tanks have welded steel plate covers lined with rubber and vented to the atmosphere through rubber-lined ducts and fans.

The acid tanks, which are 59 ft long × 8 ft 6 in. wide and about 4 ft deep, inside dimensions, hold about 13,000 gal of sulphuric acid solution ranging 5 to 23 per cent acid in the various tanks. The solutions are heated by steam, with temperatures automatically controlled at about 200 F.

As strip leaves the hot scrubbing tanks, it passes through a dryer, a shear for separating the continuous strand of material, and a recoiler. Strip speed through the lines ranges up to 400 fpm, with the entry sections capable of speeds up to 700 fpm.

From the picklers, the pickled coils may proceed to the cold reduction mills for full finished production or to the tinplate department of the company's Aliquippa Works.

Coils are cold reduced in either of two tandem mills, a four-stand 54-in. mill or a three-stand 93-in. mill. Details of these mills are given in Table VIII.

Roller bearings are used on all the work roll necks of these mills, with oil-flooded bearings on all back-up rolls. Each mill is preceded by a coil box and is followed by a tension reel for re-coiling the strip. Flying micrometer gages insure accurate strip thickness, and strip tension indicators aid in proper mill operation.

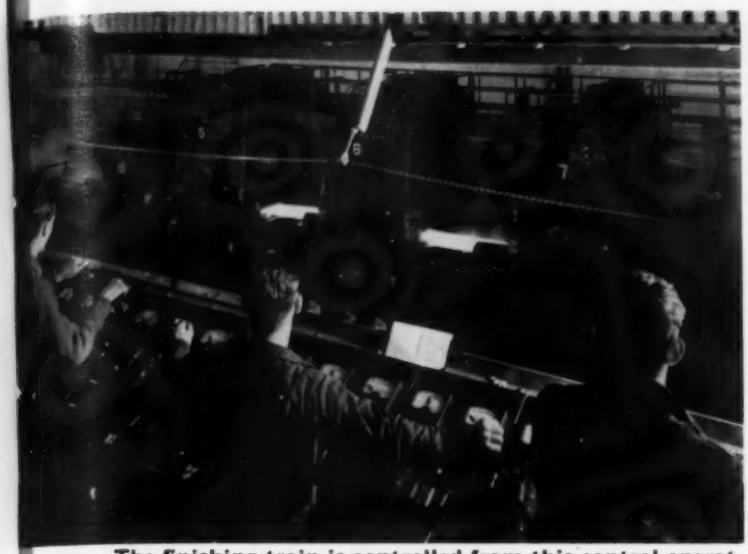
Cold mill lubrication is provided by circulating oil systems and automatic grease systems.

Power for the drive motors of the tandem mills is

TABLE IX

Strip Mill Buildings and Cranes

Building	Length, ft	Width, ft	Cranes		Span, ft-in.
			Number	Capacity, tons	
Slab yard	650	100	2	25/15	93-6
Slab furnace building	150	65	.....	.....	.....
Hot mill motor room	490	65	1	50/10	58-6
Hot mill building	725	90	2 1	75/25 50/25	83-6 83-6
Plate finishing	781	95	1 1	15 20	88-6 88-6
Hot mill finishing	781	115	2	20	108-6
Blue anneal	1078	115	3	20	108-6
Hot mill roll shop	125	60	1	60/20	53-6
Coil storage	628	70	2	15	63-6
Continuous pickling	628	70	1 1	15 35	63-6 98
Batch anneal	728	148	1 2	30/15 15	98-6 98-6
Cold mill building	906	115	1 1 1 1	75/25 30/15 15 30	108-6 108-6 98 Gantry
Cold mill motor-room	.....	.....	1	5	22-0
Cold mill finishing	553	90	1 1	15 35	83-6
Cold mill shipping	728	100	3	15	93-6
Flame cutting	.....	.....	1 1	25/15 15	.....
Armor plate shipping	.....	.....	1	15	.....
Keystone machine shop	.....	.....	1	10	.....
Keystone pipe shop	.....	.....	1	15	.....
Keystone parts storage	.....	.....	1	15	.....



The finishing train is controlled from this control operating pulpit. The mill operates with delivery speeds up to 2074 fpm.

supplied by two motor-generator sets, each consisting of two 1750-kw, 600-volt d-c generators and a 3900-kva, 500-rpm, 6600-volt, 25-cycle synchronous motor. Another 1500-kw generator on a third set can be connected to either tandem mill. This set also contains a 400-kw generator which furnishes power for a temper mill.

Two 35-hp, d-c motors operate the screwdown mechanism on each stand in the tandem mills.

The reduction in gage effected in the cold rolling process may range from 19 per cent up to 67 per cent. Strip comes to the cold mills in thicknesses of 0.075 to 0.188 in. The cold rolled product usually ranges 0.0142 to 0.0821 in. in thickness from the 54-in. mill, and 0.0255 to 0.127 in. from the 93-in. mill. Monthly capacity is set at 35,000 net tons for the 54-in. mill and 45,000 tons for the 93-in. mill.

To offset the hardness and stiffness induced in the strip by the cold reduction, the product must be annealed. For this process, there are 32 direct-fired in-and-out furnaces which take an average charge of 105 tons, 9 portable cover-type furnaces which take an average charge of 65 tons, and one portable cover furnace that takes an average charge of 430 tons.

The batch furnaces are served by a special charging machine which runs on a track paralleling the row of furnaces. Loaded boxes are picked up from loading stations and charged into the furnaces. Hot boxes are removed from the furnaces and placed at cooling stations opposite the furnaces. For the cover-type furnaces, all handling is done by overhead cranes

The furnaces are fired with natural gas, and are equipped with automatic temperature control. Fuel consumption averages about 1,400,000 Btu per ton. Usual annealing cycles run 20-hr heating time, 19 to 25 hr soaking time, and 50-hr cooling time. Departmental capacity is set at 58,400 net tons per month.

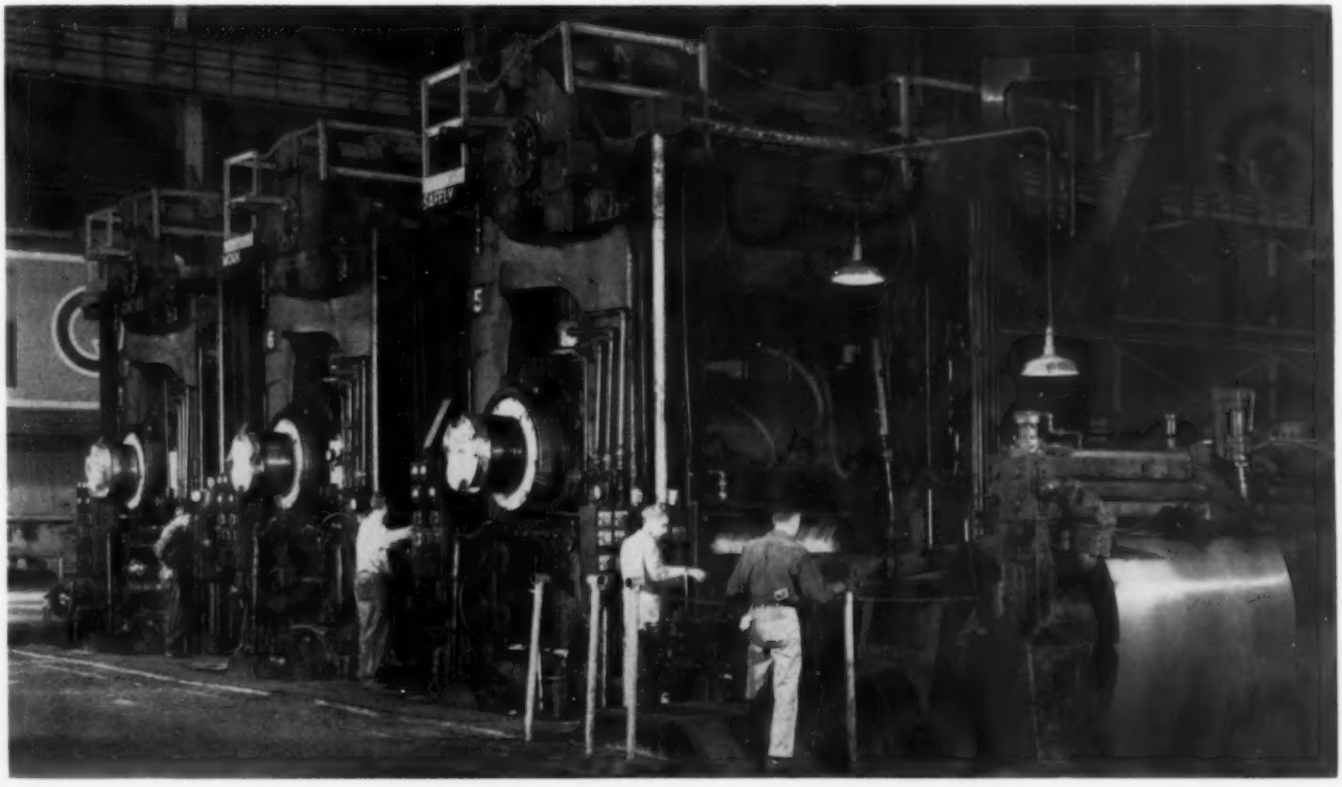
About 95 per cent of the product is annealed in coil form, 5 per cent in sheet form.

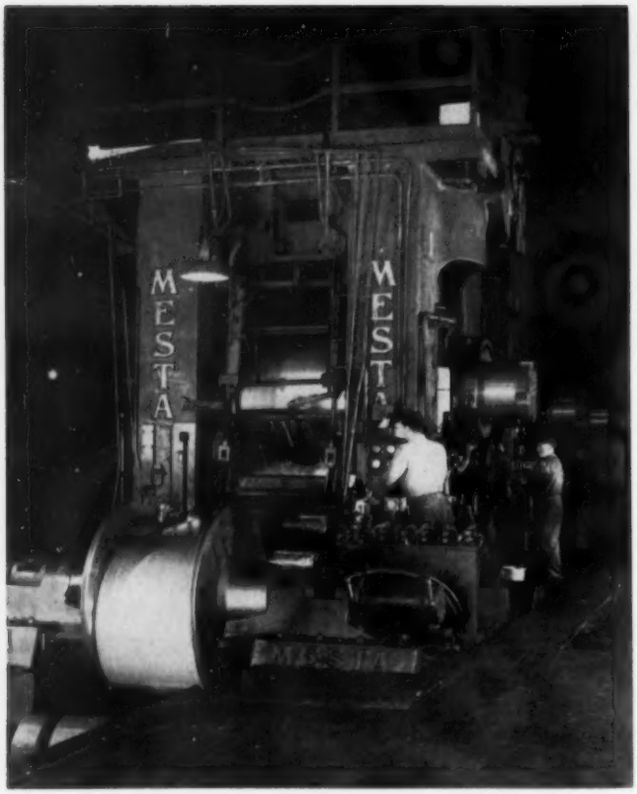
To protect the product from oxidation during annealing, a deoxidizing atmosphere is maintained within the annealing covers. This atmosphere is supplied by four gas conditioning units.

To impart good surface and modify physical characteristics of the annealed strip, it is passed through a temper mill where it receives a reduction in gage of one to three per cent. Four temper mills are installed in the cold finishing department, with characteristics as given in Table VIII.

The three four-high stands have roller bearings on

Cold rolled strip 0.0255 - 0.127 in. thick is produced on this three-stand 93-in. tandem mill, which has a capacity of 45,000 tons per month.





The four-stand 54-in. tandem cold reduction mill has a monthly capacity of 35,000 tons and produces strip 0.0142-0.0821 in. thick.

their work rolls and oil-flooded bearings on their backup rolls. The two-high mill is equipped with babbitted roll neck bearings.

The 250-volt drive on one of the 93-in. mills draws its power from the general d-c system. The other two 93-in. mill drives receive power from a motor-generator set consisting of a 1250-kw, 600-volt generator, a 750-kw, 600-volt generator, and a 400-kw, 300-volt generator, all driven by a 2450-hp, 6600-volt, 750-rpm synchronous motor. The two-high, 55-in. mill drive draws power from the 400-kw generator previously mentioned in connection with the cold reduction mills.

These motor-generator sets, together with those supplying the tandem cold reduction mills and a 2000-kw set supplying 250-volt, d-c power for the general system, are located in the cold mill motor-room, which also houses a 3000-kva bank of 6600/440/220 volt transformers for auxiliary power. An underground tunnel, in which are located the bus bars connecting the substation to the cold mill drives, also serves to conduct air for cooling the motors.

The cold finishing department also houses other miscellaneous equipment, including three 93-in. shearing lines, one 76-in. shearing line, a slitter, four resquaring shears, two roller levelers and a stretcher leveler.

SERVICE DEPARTMENTS

An integrated metallurgical department reaches into all phases of company activity, from the control of raw materials, through iron and steel production, into the finishing operations and, occasionally, even into customers' fabricating problems. Its principal functions include control of quality and recording of quality performance, proper application of all steel made, recommendation of procedures to reduce rejections and improve yield, setting up metallurgical processing, developing new methods and products, and providing technological assistance to operating departments and to customers.

The chemical laboratory, which performs all analytical work required for quality control, is housed in a well equipped modern building and has all the necessary facilities, including a spectrograph.

The metallurgical department is subdivided into three principal groups: The steelworks division, covering blast furnaces, open hearths, soaking pits and blooming mills; the bar division, covering the production of hot rolled bars and cold finished products; and the strip mill division, controlling the quality of sheet, strip, plate and coils for tin plate.

Physical testing laboratories, located in the strip mill, the bar mills and the cold finishing department, are fully equipped with heat treating and macroetching facilities, testing machines, lathes and saws, and the metallographic equipment needed to perform the tests specified by customers and by plant metallurgists. Results of tests must be approved by product metallurgists before the product may be shipped.

All orders received by the company pass through the metallurgical department, where chemical composition, ingot practices, conditioning, testing and inspection procedures are specified. Adherence to quality standards is insured by a staff of metallurgical testers and observers responsible only to the metallurgical department.

Punched-card systems are used to record metallurgical data, simplifying the compilation and tabulation of information and the evaluation of process changes.

A complete layout of shop facilities take care of maintenance work as well as a limited amount of production work. There are foundries for the production

Coiled stock may be annealed in portable cover type furnaces as shown here, or in direct fired in-and-out furnaces.

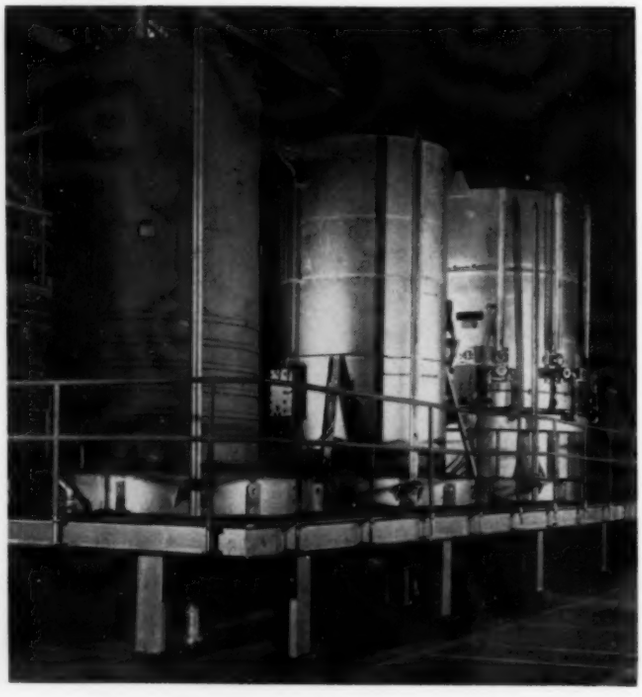


TABLE X

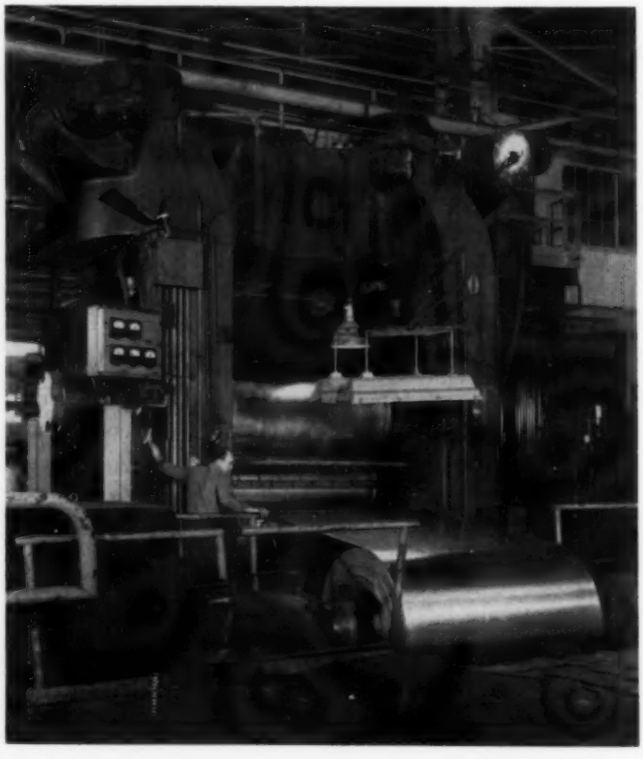
	South Side boiler house	Central boilerhouse			No. 3 boiler house	No. 4 boiler house	Coal handling		By-product	
									Breeze	Gas
No. of boilers	5	1	1	4	8	2	2	1	8	3
Type of boilers	Bent tube	Horizontal tubes	Bent tubes	Horizontal tubes	Horizontal tubes	Horizontal tubes	Horizontal tubes	Horizontal tubes	Horizontal tubes	Bent tube
Capacity, lb per hr (boiler hp)	175,000	400,000	220,000	200,000	(400)	(1290)	(350)	(450)	(508)	60,000
Steam pressure, psi	225	410	410	410	150	190	150	150	200	200
Steam temperature, F	485	725	725	725	366	508	365	365	550	550
Boiler heating surface, sq ft	19,112	23,855	18,860	24,960	3935	12,900	3500	4500	5087	5087
Water wall surface, sq ft	2035	.....	3883	0	0	0	0	0	0	1388
Superheater surface, sq ft	1430	.....	3150	.....	0	2031	0	0	958	650
Air heater surface, sq ft	9800	40,760	21,300	28,000	0	0	0	0	0	0
Combustion volume, cu ft	8550	18,500	13,000	21,000	.....	.....	620	600	1200	3000
Kind of fuel	Coal on stokers	Blast furnace gas and powdered coal	Powdered coal	Blast furnace gas and powdered coal	Blast furnace gas	Blast furnace gas	Coal and coke gas	Coal and coke gas	Coke breeze and coke gas	Coke gas and tar

of iron, steel and brass castings. Ingot molds and stools are made from molten iron direct from the blast furnaces. For other iron castings, pig iron is melted in cupolas or an air furnace. For steel castings, scrap is melted in a 40-ton basic open hearth or in a small electric arc furnace. Each foundry is equipped with molding facilities, core ovens, sand mills and conditioners, grinders, etc. The steel foundry also contains annealing and heat treating furnaces.

The forge shop contains five hammers ranging from 300-lb to 10,000-lb in size, as well as bolt machines and heat treating equipment. Some commercial forgings are made here.

In the machine shop is an excellent complement of lathes, turret lathes, shapers, planers, milling machines, boring mills, drill presses, slotters, key-seaters, broaching machine, gear cutters, grinders, presses and heat treating facilities. Large tools are located on the first floor of the shop, small tools on the second floor.

Temper mills such as this 93-in. unit improve the surface and modify the temper of the annealed strip.



A pipe shop, welding shop, structural shop, pattern shop and carpenter shop round out this part of the maintenance department.

The main roll shop, located on the south side of the river, contains some 30 lathes ranging 18-60 in. in size, and several grinders. Here rolls are finished for the blooming mills, billet mills and bar mills. There is also a roll shop at the hot strip mill containing 60-in. roll lathes, roll grinders, shear knife grinder, etc., and another shop at the cold strip mills containing roll grinders, roll blaster, etc.

As is usual with integrated steel producers, the company operates extensive transportation facilities. River traffic is handled by the traffic and transportation division of the company, which operates six towboats and 297 barges of various types. Plant shifting is done by the Monongahela Connecting Railroad which was incorporated in 1885 and which operates 32 diesel locomotives and 574 cars over its 47 miles of track. With full operations, this railroad handles about 1,600,000 tons of freight per month. The road ties into the Pennsylvania, Baltimore and Ohio, and Pittsburgh and Lake Erie railroads.

UTILITIES

With full operations, the Pittsburgh Works consumes about 3,000,000 gal of residual tar, 4,000,000 gal of fuel oil, 830,000,000 cu ft of coke oven gas and 300,000,000 cu ft of natural gas per month for open hearths and reheating furnaces. In addition, steam generation sets up a daily requirement of 403,000,000 cu ft of blast furnace gas, 900 tons of coal, and more than 300 tons of coke breeze.

A gas mixing station, located on the north side of the river, mixes blast furnace gas and natural gas to the equivalent heating value of coke oven gas, and auto-

matically introduces the mixture into the coke gas main which serves practically the entire plant except the bar mills. This station has a maximum capacity of 960,000 cu ft per hr of mixed gas.

The Pittsburgh Works uses about 30,000,000 kwhr of electricity per month. About 80 per cent of this is generated at 25 cycles in the plant, while 20 per cent is purchased at 60 cycles from the public utility system.

Power is generated at 25 cycles in the central power house located near the blast furnaces. Four turbo-generators are installed, three of which are 20,000-kw, 6900-volt units driven by 14-stage, 1500-rpm turbines operating on 410-psi steam. Each turbine is equipped with a 22,000-sq ft, two-pass surface condenser. The fourth unit is a 10,000-kw, 6900-volt generator driven by a 10-stage, 1500-rpm, 225-psi turbine equipped with a 21,000-sq ft two-pass surface condenser. Steam consumption averages about 12 lb per kwhr.

Purchased power enters the plant through a number of substations, the principal one being located on the south side of the river and containing two 20,000-kva, 69,000/13,800-volt transformers. Power from this station is distributed to the blooming mills, the 10-in. bar mill, open hearth substation, boilerhouse substation and adjacent areas.

There is also a 3750-kva, 22,000/4160-volt station supplying part of the coke plant and pumps. Four smaller stations, 300 to 500 kva, supply 460-volt power for miscellaneous auxiliaries.

Distribution of 25-cycle power is entirely by overhead open wire, while 60-cycle power is carried principally by cable, part overhead, part underground. The two systems are tied together by a frequency converter consisting of a 15,000-kva, 13,800-volt synchronous unit on the 60-cycle end and a 12,500-kw, 6600-volt induction unit on the 25-cycle end. The converter can be operated so as to feed either way, but normally draws from the 60-cycle system and feeds into the 25-cycle system.

D-c power comes from motor-generator sets and, in the newer installations, from rectifiers. These units are located in the various principal load centers in the plant, keeping d-c transmission at a minimum.

Steam for all plant use is generated in six boiler houses which are tabulated in Table X.

On the south side of the river, one house containing five boilers produces 225-psi steam for use in the billet mill engines, open hearth fuel atomization, river pumps, plant auxiliaries and miscellaneous heating.

On the north side of the river, one house containing 11 boilers, generates steam at 200-psi pressure for use in the coke and by-product plant, and in the bar mills and cold finishing department. A second house, with three boilers, supplies 150-psi steam, principally for the coal handling station.

Major steam generation facilities are centered around the blast furnaces, where three boiler houses generate steam at 150-psi, 190-psi and 410-psi pressures. The 410-psi steam is used principally by the three 20,000-kw turbo-generators and the blast furnace turbo-blowers. The 190-psi system supplies the 10,000-kw turbo generator and one blowing engine, while the 150-psi system serves the ten blowing engines, the strip mill, and miscellaneous plant usage.

Rapid determination of steel analysis as provided by the spectrograph helps to speed up production and improve quality.

The various steam systems are tied together so as to give a high degree of flexibility. From the 225-psi system on the south side, a 14-in. line crosses the river and ties through reducing valves into the 150- and 190-psi systems on the north side of the river. The 190-psi system and the 150-psi system are connected through a reducing valve and desuperheater. The 410-psi system is also tied into the 190- and 150-psi systems through reducing valves and desuperheaters. In addition, several auxiliary turbine drives operate as topping units, exhausting into the 150-psi system.

Service water is supplied by four pumphouses which draw water from the Monongahela River. With full operations, these four pumphouses provide about 365,000,000 gallons of service water per day. One pumphouse, containing two 10,000-gpm pumps and two 5000-gpm pumps, all motor-driven, supplies water to the by-product plant and the two bar mills. Another house contains nine pumps, one of 60,000-gpm, two of 45,000-gpm, two of 35,000-gpm, three of 20,800-gpm and one of 11,500-gpm. Two of these pumps, are driven by steam turbines, the others by motors. This house serves the blast furnaces, strip mill and miscellaneous departments on the north side of the river.

On the south side of the river, a new pumphouse, containing three 21,000-gpm motor-driven pumps, supplies No. 4 open hearth shop. This station is connected by a 20-in. main to the fourth pumphouse, which contains five turbine-driven pumps ranging 4800 gpm to 20,000 gpm in size and supplies the older open hearths, the blooming and billet mills and miscellaneous departments.

Self-cleaning, traveling intake screens are installed at the blast furnace and open hearth pumphouses. The river water is limed at all pumphouse intakes to offset acidity.

Water for boiler feed purposes receives a lime-soda-zeolite treatment in a central treating plant serving all boilerhouses. This requirement is approximately 2800 gpm.

Mechanical Features of Modern BAR and ROD Mills

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Birdsboro, Pa.

. . . . refinements in engineering and auxiliaries enable the operator to produce better bar and rod at increasing speeds . . . .

▲ IN a recent discussion about a proposed new mill, the chief engineer was heard to say of his plant manager, "He will never be satisfied until he can press a button in his office every morning and have the mill start up by itself." It is certain that such a mill will never be built. It is just as certain that managers and engineers will always keep trying to build one.

This paper will mention, without any attempt at being comprehensive, a few new mechanical features of bar and rod mills that are contributing to this ever improved performance.

Billets are getting bigger and harder to handle and require more passes. The conventional three-high mill is difficult to mechanize, and lacks flexibility. Continuous roughing trains are suitable for high tonnage, single purpose mills, but lack the flexibility required in multi-purpose and alloy mills. Two such mills recently constructed have utilized 20-in. two-high reversing roughing mills, completely mechanized with side guard manipulators and motorized screwdowns. One of these units is shown in Figure 1.

A new bar mill at the Green River Steel Co. has a two-high 24-in. reversing roughing mill and a mechanized three-high intermediate stand. The two-high mill was modernized as shown in Figure 2 by adding universal spindles and rebuilding the pinion stand. It starts with a forged bloom of 17 x 15 in., and reduces it to a billet of from 4 to 10¼ in. square for delivery to the intermediate mill. The new three-high 24-in. mill and tilting table are shown in Figure 3. Here the piece is worked by diamond and square passes to a diamond for finishing down to 3-in. square, or oval for finishing 3 to 8½-in. round in a two-high finishing stand in one pass. Flats up to 10 in. wide can also be made.

Figure 1 — The use of 2-high reversing roughing mills gives flexibility to the operator.

Figure 2 — Mill was modernized by adding universal spindles and rebuilding the pinion stand.

Heavy tables such as this, when mechanically counterweighted become cumbersome and sluggish, and if the tilting motion is made fast enough to meet operating requirements, excessive wear and tear on machinery and foundations result. Therefore, hydraulic counter-balance is indicated.

Hydraulic counterbalance and operation has been used successfully on many smaller tilting tables. On a table handling pieces of this size, however, it is desirable for the operator to be able to vary the stopping

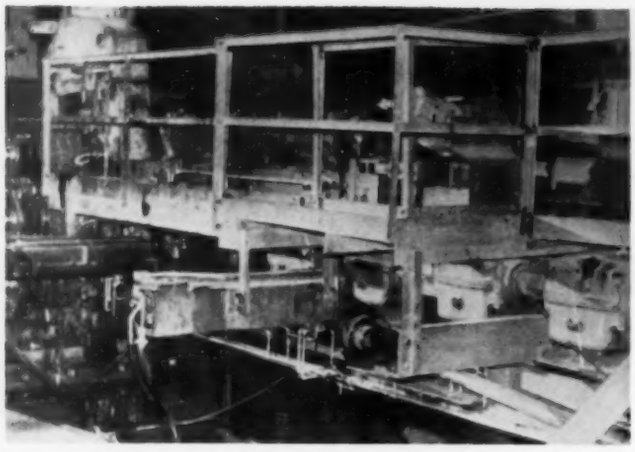


Figure 3 — Mill at Green River has a 24-in. reversing roughing mill and mechanized 3-high intermediate stand.

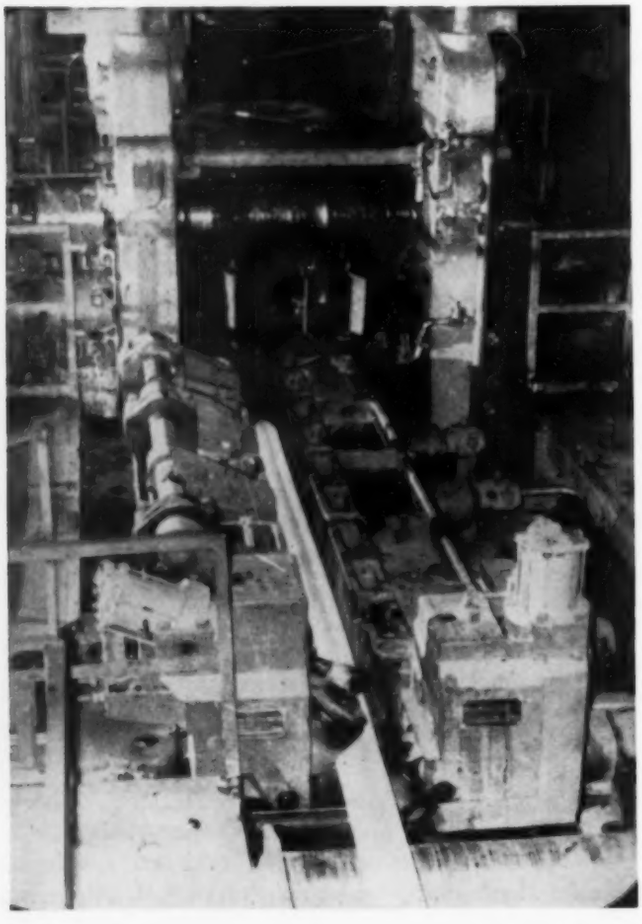
position of the table to accommodate various rolling conditions, such as edging passes, flat passes, and hooked ends. The large valves required for operation of a heavy table do not lend themselves to such precise control, however.

For this table, therefore, a combination of hydraulic counterbalance and mechanical operation is used. The hydraulic unit also supplies oil for operation of the finger lift cylinders, which are mounted on the traveling side guards and fed through slide pipes.

The positioning drive is powered by a 50-hp mill motor, through a reduction gear and crank. The crank motion has the advantage of slowing the movement at each end of the stroke, making accurate positioning possible. The tables are mechanically connected to insure that they will move up and down together.

Both the two-high roughing and three-high intermediate mills shown in Figures 1 and 3 are obliged to handle shapes not readily turned by lift fingers. Both are provided, therefore, with auxiliary turnup rolls mounted on the traveling sideguards. The three-high mill unit, for turning up squares on the corner is shown in Figure 4. A similar unit for turning diamonds can be used on the other side of the mill.

Figure 4 — Auxiliary turnup rolls shown turn squares on the corner.



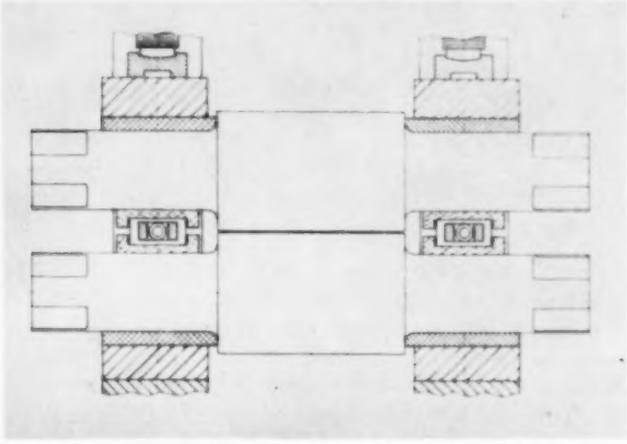


Figure 5 — Conventional construction has synthetic resin radial bearings and thrust collars.

Turning now to mill stands, a question of prime interest is the type of bearings to be used.

Synthetic resin radial bearings and thrust collars as shown in Figure 5 illustrate conventional construction.

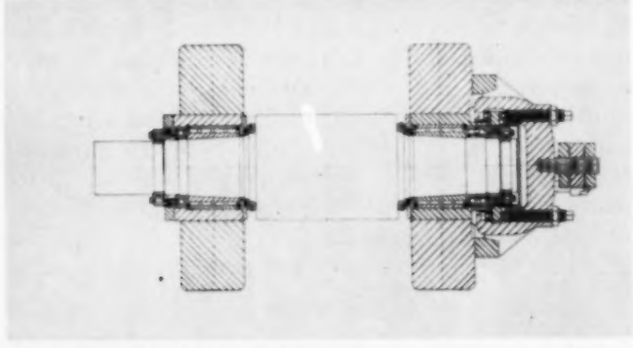


Figure 6 — Synthetic resin radial bearings may also be used with separate thrust collars.

The radial portion of the bearing gives satisfactory performance but the end thrust leaves much to be desired. The area available for end thrust bearing is limited, and is exposed to scale. The thrust bearings have the entire body of the roll between them, and expansion of the roll is likely to overload the end thrust if the mill crew is not attentive. Great skill is required by the operator to hold the roll tightly enough for proper pass alignment, without burning the thrust collars, and for making necessary adjustments. Excessive wear of the thrust collars requires frequent adjustment and bearing change.

Synthetic resin radial bearings with separate thrust bearings may also be used. These thrust bearings are generally of anti-friction type, as shown in Figure 6.

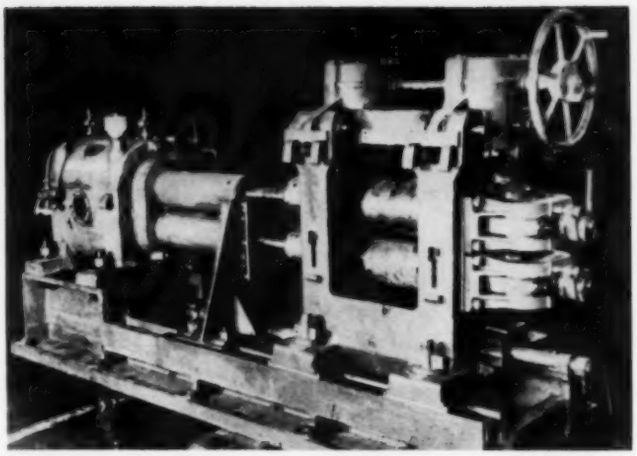


Figure 7 — This 10-in. bar mill uses synthetic radial bearings with separate thrust bearings.

Both rolls are held at the same point, so that the effect of expansion of pass alignment is minimized. The bearings are totally enclosed, facilitating lubrication and eliminating scale contamination. The bearing housing is held in a yoke just snugly enough so that it may move up and down with the roll and still hold the roll axially. The holding is done by self-aligning pads. Indentation of the mating surfaces is thus avoided. The clearance can be maintained according to the operator's desire by setting an adjusting screw on which one of each pair of pads is mounted. The yoke in turn is held adjustably to a heavy frame mounted on the roll housing. Adjusting nuts on the connecting stud permit accurate adjustment of the rolls endwise.

A view of a 10-in. bar mill stand of this design is shown in Figure 7. An application as used for a 10-in., 6-stand continuous rod mill train is shown in Figure 8. The bearings in their housings are readily removed as a unit from the end of the roll, but are preferably left on the roll until it is worn out.

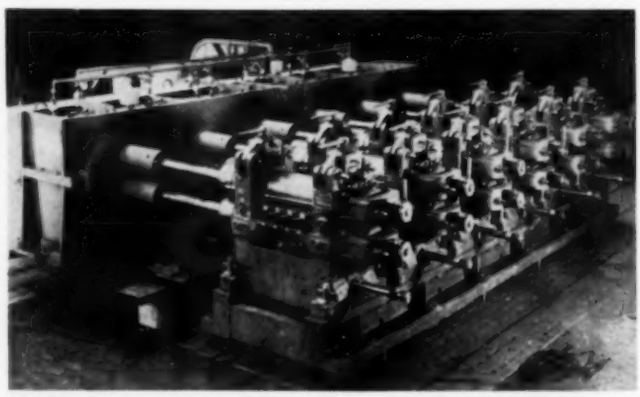


Figure 8 — Unit shown is a 10-in., 6-stand, continuous, rod mill train.

A variation of this form of bearing is a synthetic resin end thrust bearing included with the radial bearing in a totally enclosed chuck as shown in Figure 9. Scale is effectively excluded from all bearings and bearing cooling water can be recirculated if desired. The chucks on each end of the mill are joined together by a frame, so that the roll and chucks may be assembled outside the mill stand and placed in the stand as a unit. A slot on the chuck frame fits over a stud which is set in the mill housing. Nuts on this stud provide endwise adjustment. A screw on the chuck provides for adjustment of the running clearance, and takeup for wear. In seven years of operation of such a unit in a rod mill continuous finishing train, thrust collars have been replaced only once.

It has been stated, and generally confirmed by experienced operators, that 95 per cent of the troubles with water lubricated bearings of conventional design are related to the thrust bearing. The separately designed thrust bearing effectively minimizes these troubles. Wear on the radial water lubricated bearing, with proper design and lubrication, is usually so small as to be unnoticeable during the life of a roll groove.

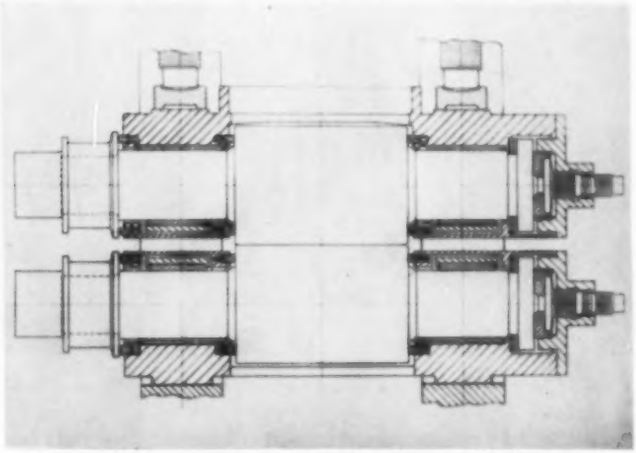


Figure 9 — The synthetic end thrust bearing may be included with the radial bearing in a totally enclosed chuck.

A typical application of full anti-friction bearings is shown in horizontal section in Figure 10. Straight radial bearings are combined with ball end thrust bearings. The chuck is held axially by a yoke and frame similar to that described above.

This type of bearing represents the best available where accuracy of gage is paramount and first cost is secondary. Roll settings may be made with precision, and will hold with a minimum of spring and wear for long periods. Non-ferrous applications, where long groove life is obtained, may benefit especially from this construction.

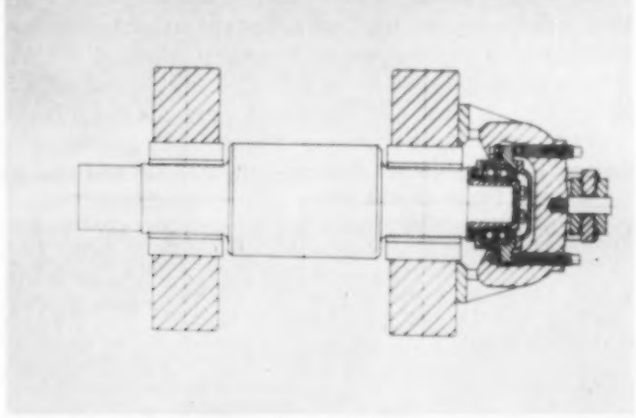


Figure 10 — It is believed that full anti-friction bearings combined with ball end thrust bearings give best results when very accurate gage is required.

Initial cost of this equipment is high, and maintenance is likewise. Rolls require accurately ground tap-

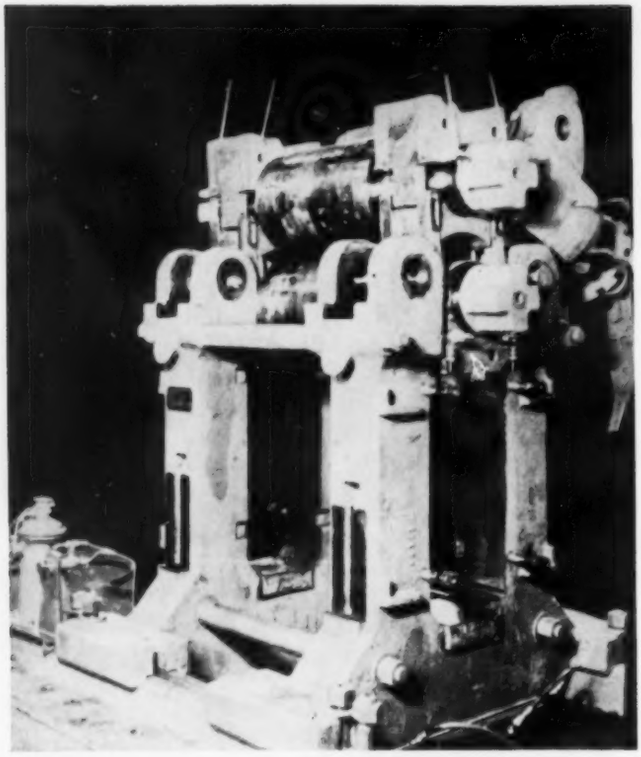
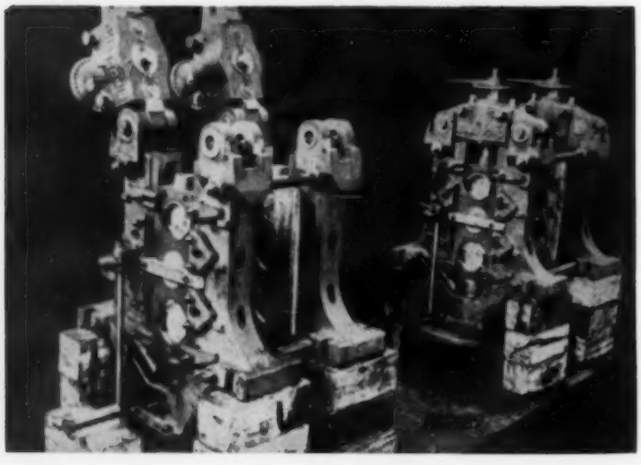


Figure 11 — Mill stand shown is equipped with a tilting cap.

ered necks, which bring a substantial extra from the roll maker. Disassembly of the rolls, chucks, and bearings cannot well be left to the mill crew, and should be done in a separate shop by skilled mechanics.

Looking for a moment at the mill housing, we find a demand for more rigidity and solid housings are sometimes recommended. Where bearings and chucks are assembled as a unit to the rolls, so that the entire assembly can be balanced out through the window, this arrangement is practical. With the simpler type of bearings, however, where the various bearing elements and the rolls are assembled in the stand by the mill crew, solid housings would be very inconvenient. Further, solid housings limit roll collar diameter to window width, which is sometimes a handicap, especially when structural shapes are to be rolled. A mill stand with a tilting cap, as shown in Figure 11 provides the advantages of both solid and open housings. The four heavy shear pins, each in double shear, develop full housing strength. With the cap tilted back, as shown, rolls and chucks can be lifted out directly. A further refinement is also shown in this figure. By interlocking the bottom and top roll chucks with a loose pin, the entire assembly of top and bottom rolls and chucks can be removed in one lift. In many cases, this may be an economical alternate to having extra set up stands. The only disadvantage of this alternate is the need for setting guides in the mill.

Figure 12 — In this rail slitting mill, all rolls and chucks may be taken in one lift.



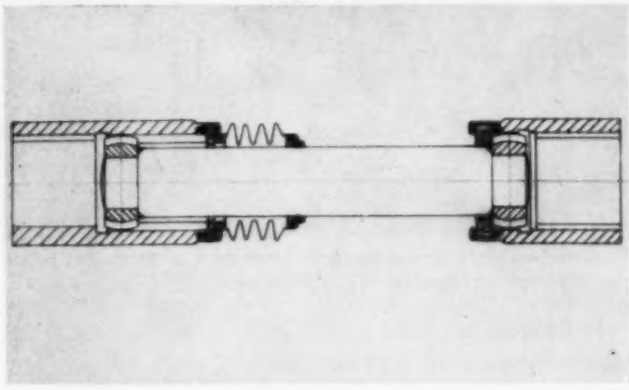


Figure 13 — Spindle and couplings shown are used where clearances are small.

Hydraulic plungers set in the bottom chuck provide the simplest means of top roll balance. Sufficient movement is available for variations in roll diameter and running "off the face" as required, without any manual adjustment of spring hanger or wedge bolts. Roll changing is likewise simplified. For the stand shown, which will be isolated from any other hydraulic system in the mill, pressure is provided by a self contained, air actuated intensifier, entirely automatic in operation.

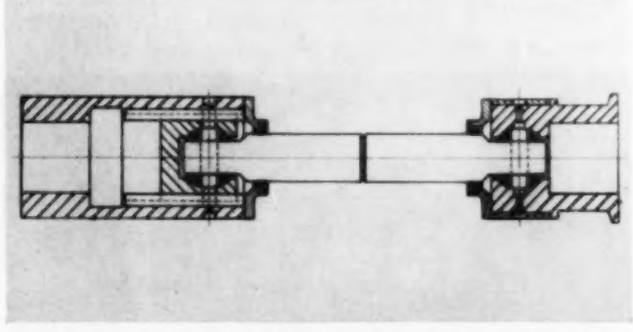


Figure 14 — Universal spindles with slipper couplings have given good results when proper care has been taken to exclude dirt and handle lubricant.

Figure 12 shows three-high stands made for a rail slitting mill where roll changing is frequent. These chucks are similarly interlocked to permit all rolls and chucks to be taken in one lift. A set of extra chucks and rolls is built up in racks, before roll changing.

High speed mills such as modern rod mills are very apt to have difficulty with spindles, due to vibration and consequent wear and tear on associated equipment. Further, modern bearings with low coefficients of friction permit rolls to overrun, with severe backlash when pieces enter the rolls. This backlash is hard on equipment, and often produces hooked bars.

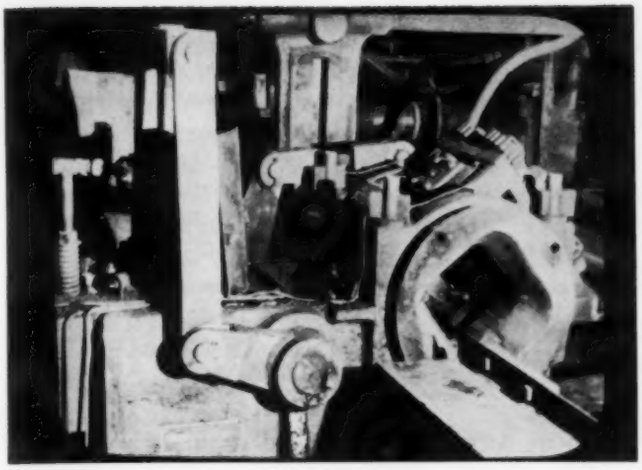


Figure 15 — Rollers are set in bronze bushings on this turner.

Gear type spindles, and couplings as shown in Figure 13 have been used, to permit small clearances. However, they are costly to make, and are subject to considerable wear, so that they have sometimes been a questionable refinement.

Universal spindles with slipper couplings have been used with varying degrees of success. In general, when lubrication has been poor and exclusion of dirt faulty, poor results have been forthcoming. However, the slipper type couplings shown in Figure 14 have operated in a rod mill finishing train for seven years without slipper replacement. It should be noted that the slipper cavity is completely sealed for retention of lubricant and exclusion of dirt.

Bar turners are used with increasing frequency in bar mills of the cross country type. Where live roller tables are provided, they can be used to eliminate manual labor in turning up flats, diamonds, squares and ovals.

To minimize resistance to bar travel these units should be provided with rollers. Since the height of the centerline, above the table line of the various sections to be turned, will vary, the centerline of the turner must be readily adjustable vertically. In addition, the irregularity of each section will force the centerline of the section to rise during the turning operation. Further, curvature of the bar may force an additional rise of the centerline, and if the turner centerline is fixed, the bar will wedge and stall between it and the table rollers. The centerline cannot be kept permanently high, or loss of traction on the table will result. Therefore, the turner trunnion should be free to float during the turning operation.

While shaped rollers may be required for some sections, flat rolls may be used for flats, diamonds, and squares. Most sections will require a 90 degree turn, but some will require less, and the linkage of the turner must permit variation. Since it may be necessary to change rollers occasionally for different orders, either the trunnion with the rollers, or the rollers themselves should be readily replaceable by the mill crew. In addition the rollers must be readily adjustable as to opening between them and their adjustment should provide for keeping the centerline of the opening coincident with the centerline of the trunnion.

The turner shown in Figure 15 has rollers journaled

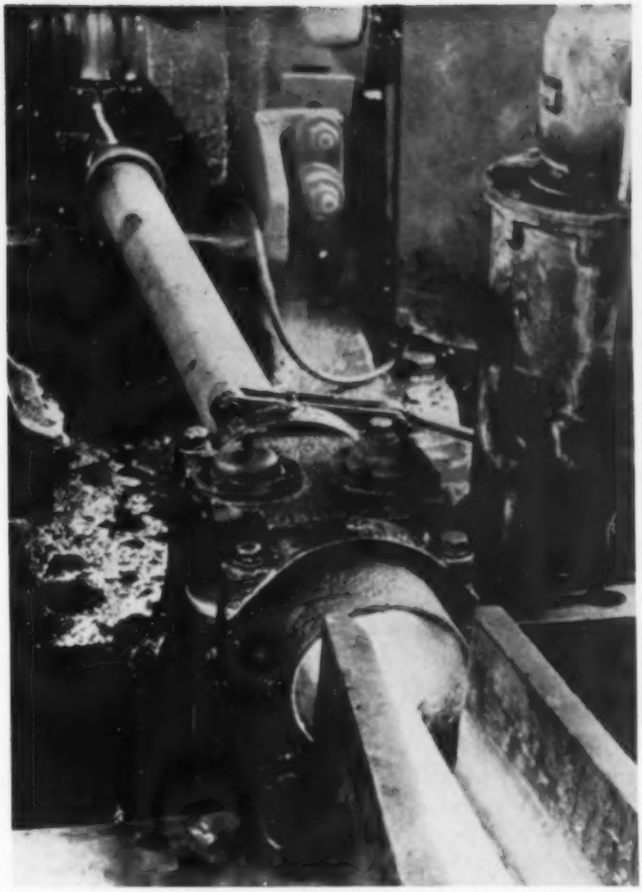


Figure 16 — Turner illustrated is relatively simple and uses a fixed mounting.

in bronze bushings. Anti-friction bearings are also used, but the practice of flooding the turner with cooling water sometimes makes lubrication of these bearings difficult, and bronze bushings seem to give less difficulty.

The rod at the left carries nuts which are used to set the height of the trunnion, and springs which permit the trunnion to be deflected up or down during operation, to suit variations in the bar section and straightness. The trunnion caps are keyed on so that the entire trunnion and roller assembly can be changed quickly.

Other turners are arranged so that the rolls and bearings can be changed easily by removing four cap screws.

Figure 17 — With care, difficult sections may be handled by the repeater.

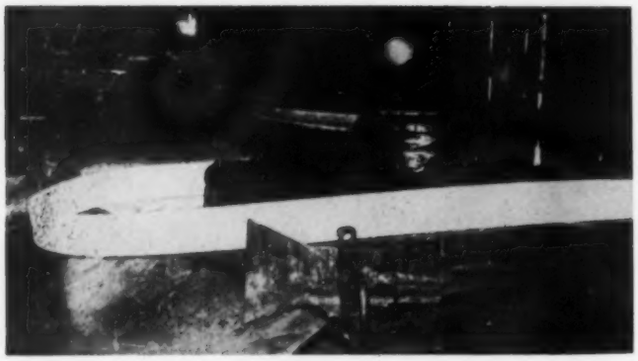


Figure 18 — Repeater shown handles skelp up to 6-in. wide.

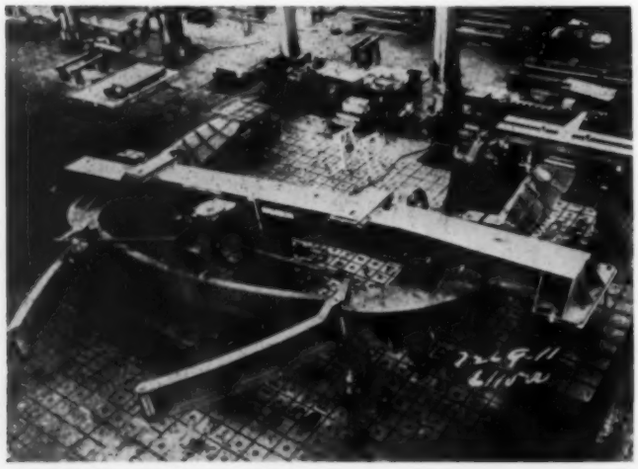
The roll opening is adjustable with one nut on the head of the turner. The rollers are kept square and centered at all times. The trunnion bearings are permitted to float vertically by a pivot mounting. The entire turner assembly can be traversed horizontally by screw and ratchet to line up with the proper pass.

For rod mills where a fixed oval or square is to be turned continuously at a certain pass, a relatively simple turner with fixed mounting, as shown in Figure 16 may be used.

If mill supervision is willing to take the pains and temporary delays involved in making initial adjustment, many sections formerly considered difficult to repeat may be handled by repeaters. Figure 17 shows a double repeater handling ovals of a 12-in. mill, one for $1\frac{1}{16}$-in. square and one for $2\frac{1}{32}$-in. square. In such a unit, the distance of the repeater from the mill must be carefully proportioned to the stiffness of the bar, so that adequate space will be available for the bar to break out of the repeater trough. Adjacent troughs and guide pipes must hold the bar well enough to force the front end around the repeater and into the next pass. Resistance to the travel of the front end must be minimized at all points to prevent premature break out. Figure 18 shows a repeater handling skelp up to 6 in. wide. With such a unit, an air or electrically operated "kicker" is used to lift the loop out of the repeater.

On a larger scale, is a repeater for 24 in. wide skelp, repeated between mills on 32-ft–6 in. centers, as shown in Figure 19. Because the bar is shorter than the loop, two pinch rolls are used to carry it around the repeater.

Figure 19 — This repeater is designed to handle 24-in. wide skelp.



Under the prodding of our competitive economy the mill builders are constantly striving to offer more efficient equipment with mechanical refinements such as described above, and many more. Most of these improvements are made as a result of the comments of observant mill operators concerning the shortcomings of existing equipment.

DISCUSSION

PRESENTED BY

LOUIS MOSES, Mill Engineer, Bethlehem Steel Co., Bethlehem, Pa.

H. H. Angel, Electrical Engineer, Bethlehem Steel Co., Bethlehem, Pa.

C. E. PRITCHARD, Superintendent of Mills, Alan Wood Steel Co., Conshohocken, Pa.

A. E. CICHELLI, Lubrication Engineer, Bethlehem Steel Co., Bethlehem, Pa.

L. F. COFFIN, Assistant General Manager, Bethlehem Steel Co., Sparrows Point, Md.

CHARLES W. DUNN, Technical Coordinator, United States Steel Corp., Fairless Hills, Pa.

WILLIAM H. BOBLITZ, Rolling Mill Engineer, Rustless Works, Armco Steel Corp., Baltimore, Md.

E. C. PETERSON, Engineer, Birdsboro Steel Foundry and Machine Co., Birdsboro, Pa.

Louis Moses: The severally described items of equipment have not only greatly influenced the design of modern mills but adaptations of them, when applied to older mills, have provided improved practices and lower costs of operation. It is difficult to determine whether the need for means to produce a better rolled-product comes first or if efficiency in operations takes precedence. However, this is immaterial because an increased rate of efficiency always accompanies any adopted means to improve surface quality. By the same token a better product is always rolled when equipment is installed with the prime objective of promoting efficiency. The major reason for this is that the unit as a whole has facilities built-in for a high standard of product excellence. Not to be discounted is the operator's lessened need for concern on just how his equipment holds itself at any given degree of adjustment. When relieved of such worry his whole effort can be directed toward squeezing out a few more billets per hour, knowing that the product will not be adversely affected thereby. Another valuable by-product consists of this being possible without the mill-operators exerting any extra physical effort and their manifested pride in the accomplishments of the unit.

The closing paragraph of this excellent paper reflects the partnership between the steel-industry and the mill-builder. Again it becomes a question whether the mill-builder's vision, plus his ability to implement it, is paramount or if he "sweated-out" the engineering of the operator's ideas.

There are instances of bar-manipulators developed by the mills and roll shops which display remarkable efficiency coupled with extreme simplicity of construction. These may consist of simple, cast, guides mounted on the rest-bar but sometimes on the table in the path of bar travel, the bell-mouth receiving the bar, the loosely fitting interior being helically cored or built up by welding, to rotate the bar to a desired amount. A successfully engineered design of this occurs on one of the industry's most recent mills, turning billets from their flats on the furnace hearth onto their corner-axes for entry into the first, diamond-shaped pass. In another case, a wedge-shaped piece with no covering member will be fastened to a table located off-center of the bottom face of a traveling bar to rotate it ninety degrees. This type of table "flipper" has been variously used for decades, in one case turning large ingots before entry into the rolls, another case manipulates billets. An adaptation consists of a suitably arranged, off-side located, idle roller set into the apron-plate and adjusted to the proper level to perform the same function of turning the bar. Such movements utilize the momentum of the forward moving bar which causes the bar to rotate the desired quarter-turn by "rolling with the punch." One plant which employs a number of these home-made devices is very careful to locate them as closely to the rolls as possible to insure the most effective control at bar-end as it enters the rolls.

These devices, effective as they are, by no manner of means can discount those which Mr. Peterson describes. Many mechanical-turners are in use as essential facilities, and more applications could doubtless be made with profit. Their advantage consists of turning a bar, when stopped at a requisite table position, with complete certainty that the manipulation will be completed rather than depending entirely upon "catching it on the fly." In fact some mill layouts involve bar-transfers which do not permit of any other type. Dependent upon the diverse products rolled, the location of mechanical-turners ranges from twenty to forty feet away from the rolls. This distance becomes an important factor with small cross-sections whose limberness may or may not permit maintaining a desired axial-position throughout such lengths. The conveying rollers could be made to assist holding them up by grooving, but this again is not always possible to do because other mill products require straight-faced rollers.

A consistent production of close-tolerance sections having unmarred surfaces, at good tonnage rates sustained hour after hour, can not be accomplished without dependable roll-neck bearings. To the paper's described adverse influences of the conventional bearing can be added the hazards of faulty bar-surface caused by maladjustments of rolls anywhere in the train. Every pass requires an accurate registry of paired roll-grooves to insure against collar marking. Instances of seaminess on the surface of otherwise perfectly sound product have been caused by a very slight amount of roll-crossing. This difficulty with conventional bearings and their face-wear, requires constant watchfulness as well as great skill on the part of the mill roller. All hail to the roller bearing!

The Belgian-type mills stand in similar need of improvements over their present means for holding the rolls end-wise. The roller-bearing end-thrust devices cannot be used because the open-ended space permitting their use on tandem-arranged mills is completely occupied by coupling-boxes and driving-spindles. For this reason, the conventional bearing, with its face-wear, is the only type thus far found to be possible. Here is a matter into which both mill-builder and the talent in the plants can set their minds and come up with a solution to a long felt need on these older mills.

The design of varying spindle types are compared and their values analyzed in a recent paper on the application of torque to rolls, "Delivery of Torque To Rolls," by Louis Moses, 1952 proceedings AISE, p343. In noting that Mr. Peterson shares many of the conclusions stated therein it may be added that the modern gear-type spindle, and other types as well, largely eliminate the damaging end-thrusts not traceable to rolling actions. The modern machined spindle and flat-faced wobblers are real investments with returns in operational costs as stated with conceivably even greater ones when their effects on better rolling is considered.

Every installation of looping tables throughout the land and abroad has its own distinctive peculiarities, mostly because of the kind of rolling practices employed. The use of loopers and repeaters extends further back than the memory of living men. Despite this long usage, there are few rules to follow in any given instance such as how best to turn a repeated-oval for the most favorable action of "breaking-out." Certainly there is nothing published on the matter. A contemplated installation requires a bit of study and comparison with existing ones performing the intended function. Nevertheless, some cross-sections and larger geometrical ones, heretofore believed to be virtually impossible for looping, are being presently handled in the device.

H. H. Angel: In the illustration showing a long bloom about ready to be turned, you mentioned turning it 45 degrees with manipulator fingers would be difficult. I do not remember if the stand was reversing or continuous. I would like to know what type stand was used and how the product was turned 45 degrees. If the manipulator fingers were used, was the drive stopped by limit switch or by the operator, or was the turning accomplished some other way.

C. E. Pritchard: It was noted on one illustration of a typical composition bearing assembly, that an additional water seal was provided. It is assumed that the material used in the construction of the seal contact ring is either composition or bronze. What experience have you encountered regarding the wear characteristics of this material for the service intended, and do you note any tendency for grooves forming on the ends of the rolls as the results of this frictional contact?

A. E. Cichelli: Mr. Peterson, you indicated that the slipper-type coupling gave you excellent service. I am curious about the type of material the slippers themselves are made of and how you lubricate them. What type material do you use?

With regard to the totally enclosed composition bearing, how do you provide for lubrication on shutdown to prevent rusting?

Do you think it necessary to supplement water lubrication with oil or grease during operation?

Member: Following the lead of Mr. Cichelli's question, I am interested in learning the details and effectiveness of the flexible seals used on the spindles and couplings.

L. F. Coffin: What is the angularity of the spindle you are able to operate with?

Member: On the anti-friction bearing on the tapered roll neck, what means do you provide for removing the inner race from the neck proper?

C. E. Pritchard: What method of mounting is employed on the tapered roller bearing assemblies to facilitate control of both the bearings and the rolls with respect to thermal expansion? Do you lock one end of the roll and allow the other end bearing and chock assembly to float?

C. W. Dunn: I would like to know the maximum bearing loading for which you have built the anti-friction type bearing illustrated in one of your figures? I was wondering if there were not some compensating operating efficiencies effected such as holding closer tolerances and longer roll life that would off-set the higher initial and maintenance cost?

William H. Boblitz: Mr. Peterson has very capably described and illustrated a number of installations and designs of mill equipment, some of which we have at our plant. Considerable interest has been shown by members present in the performance of the universal spindle. We have had three sets in service for seven years without any trouble other than breakage of flanges which was caused by inexperience of the roll changing crew in the beginning in not aligning the roll with the pinion before coupling up the mill, but this was soon corrected. I might add that the spare spindle assemblies are still in the crate as shipped to us.

E. C. Peterson: Mr. Angel asked about the manipulator which was shown turning up a square, in Figure 4. To begin with, this illustration is of a 3-high mill, but the same type of unit is also applied to the 2-high reversing mill.

I said it would be quite difficult to do this operation with a finger lift. Actually, it would be impossible, as far as I know. I never saw anybody try to turn a square up with a finger lift to 45 degrees. This unit is mounted on the end of the side guard. When the operator wants to make this manipulation, he presses a foot button, putting air pressure on the units and bringing them into operating position. He then brings the side guards together in front of the proper pass, and that is all he has to do. The rollers engage the piece and then turn it. Ovals can be turned 90 degrees with properly shaped rollers.

C. E. Pritchard: At what point on the bar do you engage the manipulator in making the turn?

E. C. Peterson: We like to have the rollers as near to the centers of the bar as we can get them. In this case we put the manipulators on the back of the sideguards. In other cases, for shorter pieces, we have built them into the middle of the sideguard.

Member: Is the sideguard air or hydraulically operated?

E. C. Peterson: Air.

Member: Is the side guard perfectly flat or cut in converging or square position?

E. C. Peterson: The side guards are flat. If you took the two auxiliary units off the back of the side guard, you would have left a conventional side guard manipulator.

Referring to Mr. Angel's second question concerning the bearings, and as to whether we know of any blooming mills with fabric bearings on the bottom as well as on the top roll.

All of our two-high reversing mills have had fabric bearings at all points on the roll necks, with the exception of one unit which had roller bearings. A sliding scale guard is placed over the bottom chuck, which is so arranged that gravity urges it towards the mill roll, and in that way we keep most of the scale away from the bottom roll neck. We also introduce the lubricant, which in this case is water, at intermediate points in the bottom roll segments, so that the lubricant does not have to carry through such a large arc. This arrangement gives, as far as I know, good results.

Now, Mr. Pritchard asked about the bearing seal of Figure 9 and whether the seal undercut the side of the roll body.

The seal has been changed. In the design shown the material was the same as the bearing material. It was a synthetic resin that proved to be too fragile. We had springs to press it against the neck and keeper-bolts to hold it in place during assembly, and as a result there was not enough section left and the seals often broke. The people at Rustless made a change—and I am going to ask Mr. Boblitz to describe the change.

Concerning the roller neck bearing, Mr. Mercer asked how it is removed. Oil pressure is used. The neck is drilled and a little oil pump is used to start the sleeve off the neck. The fit is obtained by the amount that the race is driven up onto the neck, which is quite helpful in maintaining proper clearances in the bearing. Gages must be used and accurate machine work, is required. The actual diameter of the neck is not so critical because by forcing the race on with the proper pressure the proper amount of expansion of the inner race which will give the proper running clearance can be obtained but the taper must be right.

C. E. Pritchard: Is this work performed normally away from the mill housing location?

E. C. Peterson: Yes, I would say a job like this should not be done in the mill bay. A proper arrangement is to take the whole assembly out of the mill and take it to a bearing shop and disassemble it and handle it where cleanliness is possible and nobody will go at it with a sledge hammer. This is fine and expensive equipment and has to be handled accordingly.

Mr. Pritchard also inquired as to roll body expansion, and also suggested a solution which is the one we use. The spindle side bearing chuck is held fast to the roll, but the chuck itself can float in the housing. The great advantage of this arrangement is that expansion of both rolls takes place from the same point, so that corresponding grooves move together, and crossing is avoided.

Mr. Cichelli asked about the totally enclosed water lubricated bearing and how is it lubricated during

shutdown? Here again, I would like Mr. Boblitz to touch on that matter if he will. On the open lubricated bearings on blooming mills we always provide a greasing system so that just before shutdown, grease can be applied to neck to prevent rusting. Whether something similar is done in this particular instance, I do not know. As to supplementing water with grease lubrication, it is certainly not necessary, but we know of instances, especially on blooming mills, where grease is regularly applied to the water lubricated necks, and the operators state that bearing life is materially improved thereby.

The slippers in our universal spindles are of synthetic resin material. They are grease lubricated.

A member asked about the effectiveness of the flexible seals used on the spindles and couplings. As far as we know these seals have held up satisfactorily.

Mr. Coffin asked as to the angularity that these spindles will stand. The particular ones that Mr. Boblitz spoke of were on ten-in. mill stands. He can probably tell us the maximum and minimum roll body diameter that he has used.

Mr. Dunn asked about the maximum bearing loading for which we have built roller bearing necks. We have put them on bar mills of various sizes. The largest bar mill size we have used is 14-in., and we understand that this bearing had a capacity for each neck of about 95,000 lb at 55 rpm and 3,000 hr of life. We have also put them on a small 2-high reversing mill, a 20-in. mill. That was probably the largest capacity bearing we used.

W. H. Boblitz: We have not changed the original slippers, and the spindles are grease-lubricated weekly.

We do not lubricate the necks on the continuous mill. We have found that even though this part of our rod mill does not operate for periods of a week or more, due to rolling larger sizes of rod on the 9-in. mill, only a thin film of corrosion appears on the necks, and that will clean off very quickly. We use city water on this mill which helps this condition considerably.

The seals, originally equipped in the horizontal stands of this continuous mill, were soon changed due to the springs breaking and the time required in making assembly. Several methods of sealing the water were used until recently when we redesigned the roll housings and installed split seals which have been very effective. The seals have not caused any grooving of the roll body.

The question on maximum angularity, permissible with the universal spindles, described by Mr. Peterson, is one we cannot answer. However, we can cite our present condition; that is, the maximum roll diameter being 10¾-in. and a minimum of 10-in. diameter. How much more misalignment they will run at effectively, we do not know. We have had no trouble of any type due to the stated roll diameters.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC. OF

IRON AND STEEL ENGINEER

(Required by the Acts of Congress of August 24, 1912, March 3, 1933 and July 2, 1946)

Name of Publication: *Iron and Steel Engineer*, published monthly at Pittsburgh, Pennsylvania. (Report of October 1, 1954.)

State of Pennsylvania

County of Allegheny

Before me, a notary public in and for the State and county aforesaid, personally appeared T. J. Ess, who, having been duly sworn according to law, deposes and says that he is the editor of the *Iron and Steel Engineer* and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Acts of March 3, 1933 and July 2, 1946, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher: Association of Iron and Steel Engineers, 1010 Empire Building, Pittsburgh, Pennsylvania.

Editor: T. J. Ess, 1010 Empire Building, Pittsburgh, Pennsylvania.

Managing Editor: None.

Business Manager: None.

2. That the owner is: Association of Iron and Steel Engineers, 1010 Empire Building, Pittsburgh, Pennsylvania.

No stockholders.

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3. That the known bondholders, mortgages, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

T. J. ESS, Editor.

Sworn to and subscribed before me this 8th day of October, 1954.

ALMA A. JORDAN, Notary Public

(My commission expires January 2, 1955.)

Effect of SECONDARY CHECKERS on Open Hearth Furnaces

By H. S. HALL, Assistant Manager, Combustion Control Dept., Morgan Construction Co., Worcester, Mass.

. . . . results show that secondary checkers will increase furnace production and reduce fuel requirements . . . .

▲ MOST open hearth furnaces and for that matter most steel plant furnaces have inadequate regenerators or recuperators for preheating combustion air. Most open hearth furnaces and a great many heating furnaces also do not have sufficient draft for handling the proper amount of fuel which should be burned to produce the rated tonnage output of these furnaces.

In the past two or three years, there has been a great deal of emphasis placed on the attainment of high temperature incoming combustion air to an open hearth furnace. It is generally agreed that the higher the preheated combustion air temperature, the hotter the flame and the sharper working the open hearth furnace becomes.

There are, of course, many ways of obtaining higher preheated air temperatures from existing open hearth furnaces. One is the sealing of leaks in the regenerator system to prevent the infiltration of cold air into the hot air flowing to the furnace. When practically all leakage of this sort is eliminated, then of course, we come to the problem of increasing the regenerator capacity so that a greater heat transfer from the outgoing flue gases to the checker brick and subsequently to the incoming combustion air can be obtained.

Before discussing the various methods of increasing regenerator capacity, it would be well to show exactly what can be gained in the way of total fuel input to a furnace by increasing the temperature of the combustion air.

The heat input per hour to an open hearth furnace is normally thought of as the amount of fuel in the form of coke gas, natural gas, fuel oil, pitch or tar which is being fired. Quite a few of the modern open hearth furnaces built today to tap 225 tons, or more are designed to burn around 600 gallons of oil per hour or in round figures 90,000,000 Btu per hour. Seldom does anyone speak of a higher firing rate than the above, but actually the firing rate in even the poorest design of open hearth with inadequate checkers burning 600 gallons of oil per hour will be considerably higher than 90,000,000 Btu due to the heat content of the combustion air.

There are probably relatively few open hearths in the country at the present time which will average 2000 F preheated air temperature during the entire cycle of one heat. However, assuming that we do have an open hearth furnace which will average 2000 F incoming air temperature and firing 90,000,000 Btu per hour in the form of fuel, the heat input due to this 2000 F air temperature will be increased by 34,200,000 per hour or 38 per cent over the 90,000,000 Btu which is normally spoken of, or you will actually have a total of 124,200,000 Btu per hour as the heat input of an open hearth furnace with 2000 F preheated air temperature firing 600 gallons of oil per hour.

Now assume that the average incoming air temperature is 2500 F instead of the 2000 F as noted above. The heat added in the preheated air will be approximately 43,600,000 Btu per hour which added to the 90,000,000 Btu of the fuel gives a total heat input to the

Figure 1 — Heat is increased linearly with increase in air temperature. Curve shown is made up for a firing rate of 90,000,000 Btu.

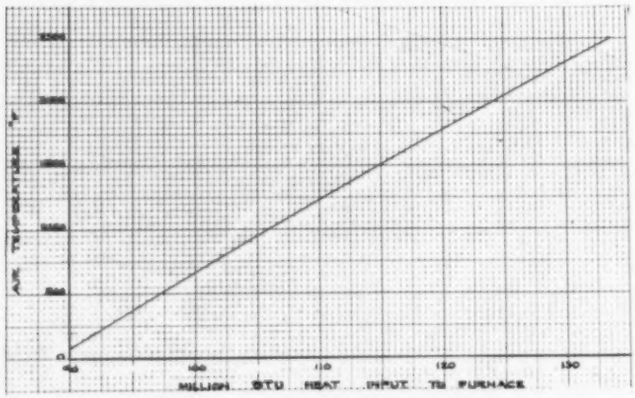
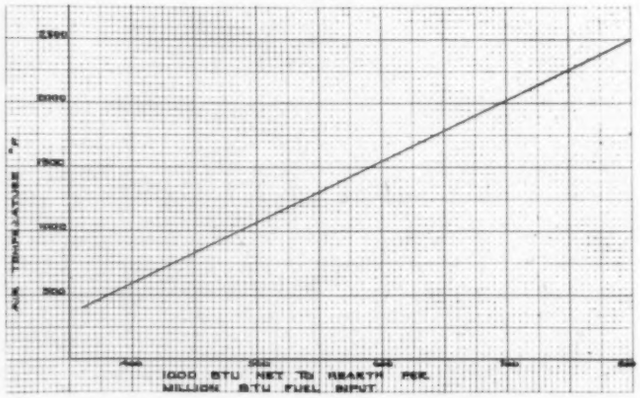


Figure 2 — Curve gives heat available to metal being melted for various incoming air temperatures.



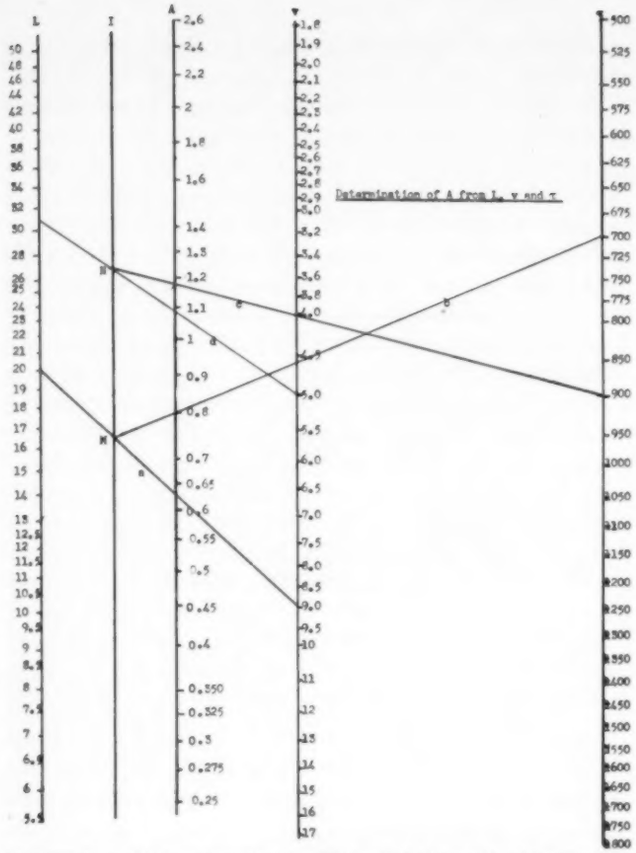


Figure 3 — Value for the coefficient A is easily determined from this nomographic chart.

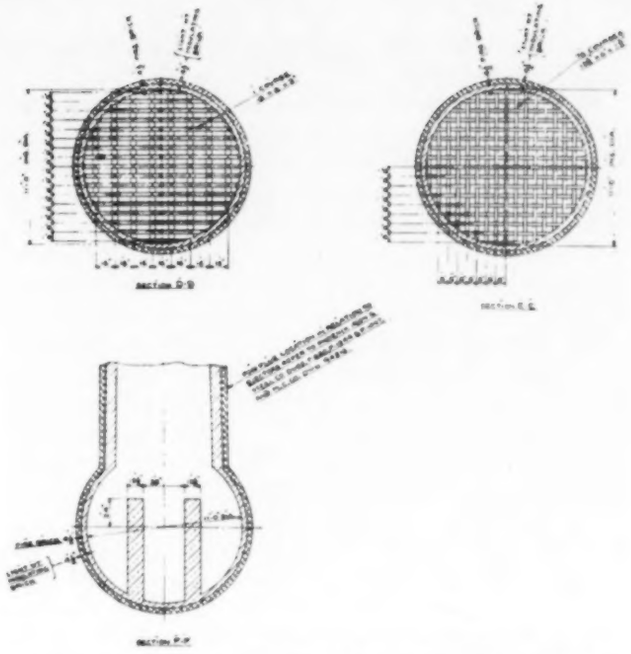


Figure 5 — Sections are taken through secondary checker.

furnace of 133,600,000 Btu per hour with an increase of about 7.6 per cent in the total heat input to the furnace merely by increasing the preheated air temperature from 2000 to 2500 F. It should be stressed that this additional heat costs absolutely nothing as far as operating costs of the furnace are concerned.

To better illustrate this, Figure 1 shows graphically the increase in heat input due to increasing air temperature with constant firing rate.

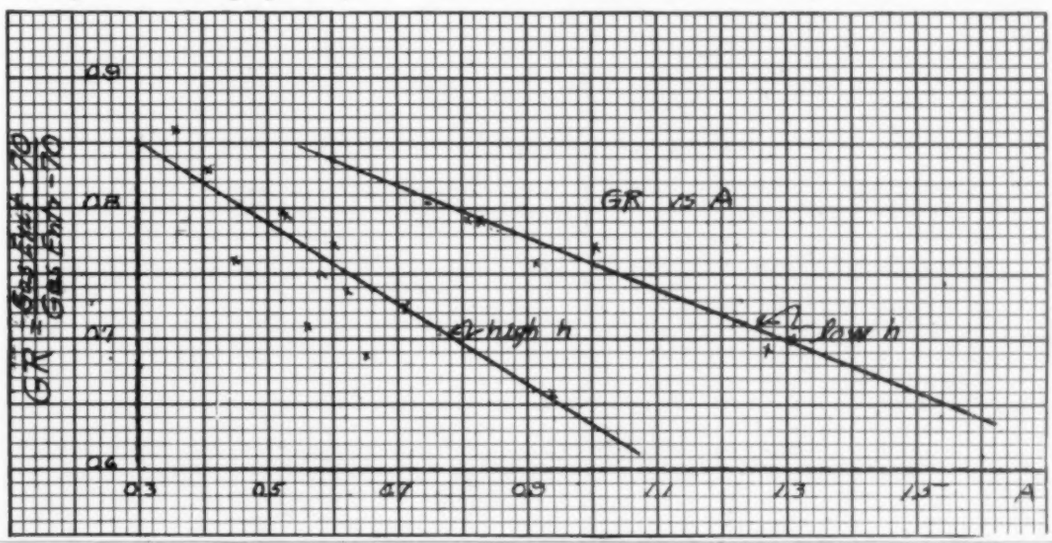


Figure 4 — Curves give data to determine the gas exit temperature as a function of coefficient A.

For heat to be transferred from one medium to another, there must be a temperature difference. At the beginning of charge of an open hearth furnace there is the greatest temperature difference at any time during the heat, so that if a high flame temperature can be obtained the absorption of the potential heat in the flame by the scrap is at its greatest rate. The sooner a flame of extreme high temperature can be generated, the sooner you will start melting cold scrap.

Figure 2 shows graphically the net Btu available to the metal being melted in the furnace per 1,000,000 Btu of fuel input with various incoming air temperatures. This is based upon a gas exit temperature of 2700 F leaving the furnace.

The curve is plotted temperature of combustion air degrees F versus 1000 Btu net to hearth per 1,000,000 Btu of fuel input. The use of this curve is very simple, assume an incoming combustion air temperature of 1700 F. The curve shows 635,000 Btu is available in the hearth of the furnace for every million Btu that is being put in the end of the furnace in the form of fuel. Assume now that by some method the temperature of the incoming combustion-air is raised to 2000 F, there is available in the hearth of the furnace about 697,000 Btu per million Btu of fuel input to the furnace. In other words, instead of being able to utilize 63½ per cent of the fuel that is being put in, it is now possible to utilize 69.7 per cent of the fuel put in the end of the

furnace and this is being done without increasing the cost of the fuel fired.

Now assume that it has been possible to increase the checker capacity so that an incoming air temperature of 2200 F is obtained. The available heat in the hearth of the furnace is increased to 738,000 Btu per million Btu of fuel input and if the incoming air temperature is increased to 2500 F as spoken of earlier in the paper, the total heat available to the furnace will be almost 800,000 Btu per million Btu fired in the form of fuel.

The laws governing the transfer of heat, when broken down to simple terms, are namely, time and temperature difference. There must be a difference in temperature for heat to transfer from one medium to another and there must be time for this transfer to take place.

If time were not an important factor in heat transfer, all that would be needed would be a large mass of material which would absorb the available heat in the flue gases in whatever time was necessary and then give up this absorbed heated to the incoming combustion-air over another long period of time. However, the normal length of travel from the outgoing port of an open hearth furnace to the flues is seldom very much more than 150 ft, with an overall average velocity of about 30 fps. This gives a total time for transfer of the potential heat in the flue gases to the brickwork of about five seconds.

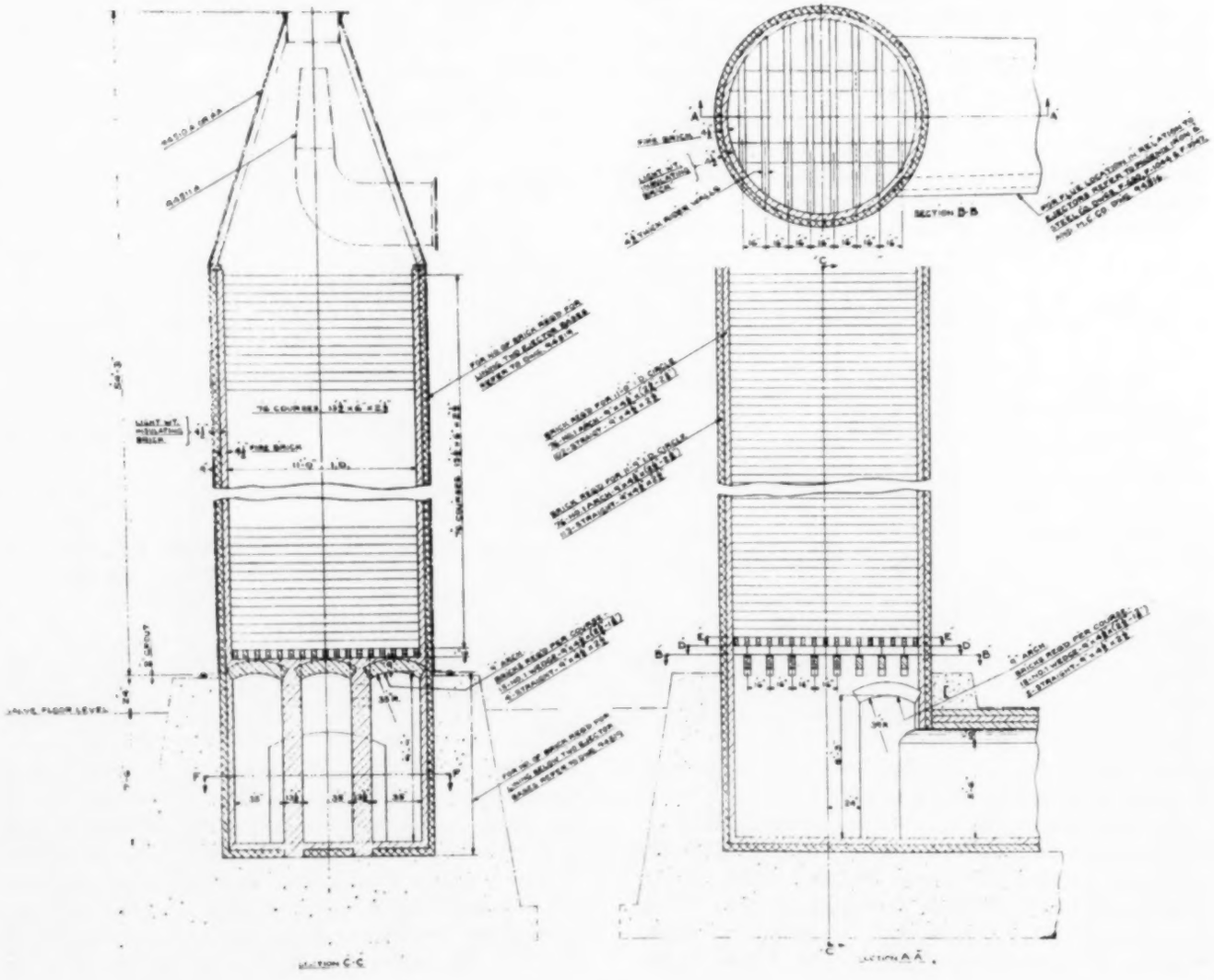
The question is how can the heat that is transferred in this short period of time be increased.

One way would be to slow down the velocity of the gases, but when this is done all control of the gases is lost and channeling in the checker chambers takes place, which allows certain portions to become hotter than other portions, and we are not definitely sure that the combustion-air flowing back through the checker chambers will come through this hottest portion.

Another method which has been tried with a certain amount of success is by using two passes in the primary checkers plus an open pass in the middle to allow the gases to change direction. This method has shown results, but normally when it has been used there is less checker brick in the checker chambers than when using them as single pass checkers. This puts a terrific heat load on the first pass of these checkers and usually results in excessive burning of the first pass checker brick.

By the use of secondary checkers in the bases of our furnace control system we are able to design these checkers for proper velocities and for proper length of travel so that we recover a considerable portion of the heat remaining in the outgoing flue gases from the pri-

Figure 6 — Elevation shows checker chamber with 40-ft length of travel.



mary checkers and return this heat to the furnace as higher preheated combustion-air.

To calculate regenerator size is rather a tedious job as some of you no doubt know, and takes considerable time.

To relieve us of the necessity of making these calculations for each furnace and also for the purpose of finding out what certain variables in the constants used for regenerator design would do to the overall efficiency of the regenerator, we asked Dr. Victor Paschkis, Director of the Heat and Mass Flow Analyser Laboratory of Columbia University to conduct a series of determinations which would show the effect of varying certain of the constants that are normally used and also which might result in the end in affording us a simpler means for regenerator design.

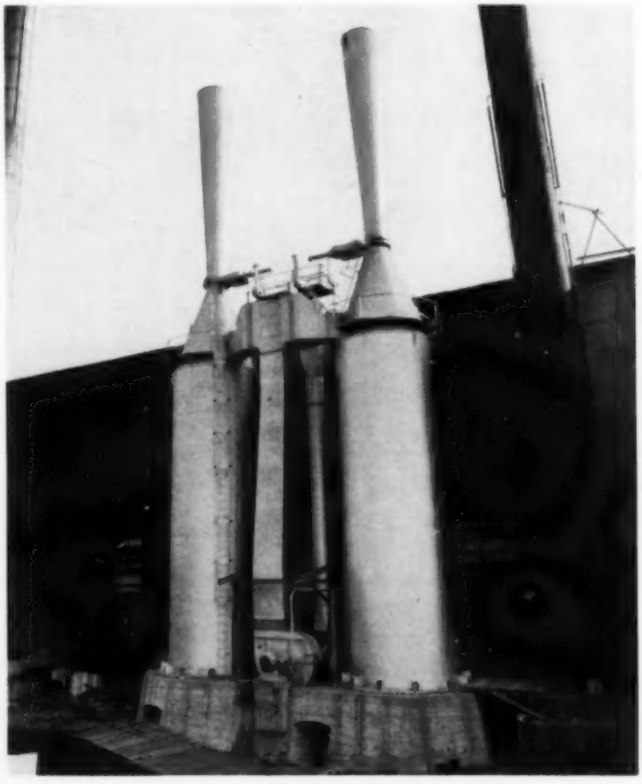
The items, whose influence was examined were length of reversal period, length of flue, gas velocity, gas entrance temperature. Later the effect of the thickness of the checker brick was also studied.

The result of all these studies by Dr. Paschkis resulted in the following equation: $A = \frac{L^{0.65}}{V^{0.27} \times T^{0.24}}$ in which L = length of flue in ft, V = gas velocity at standard conditions in feet per second and T = length of reversal period in seconds. A is used to designate the correlating factor.

The above equation is still rather a difficult one for most practical engineers to solve, so that a nomograph Figure 3 was prepared by which the correlating factor A can easily be determined for any given set of conditions.

After A is determined by the nomograph we then use the curve in Figure 4 to determine the gas temperature ratio designated GR. From this curve you can determine the gas exit temperature from the top of the secondary checkers, depending upon the conditions you used when determining A from the nomograph. By a similar curve, the air exit temperature from the checkers may also be determined.

Figure 7 — Illustration shows furnace system with 40-ft checkers.



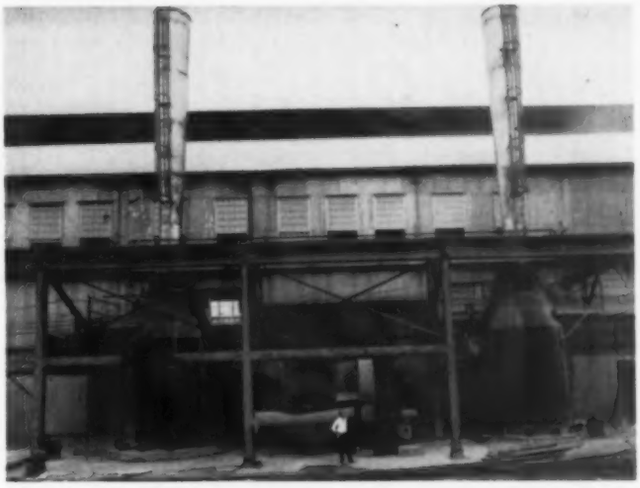


Figure 8 — In this system the bulk of the secondary checkers are located below the ground level.

This whole calculation will take approximately four to five minutes against possibly two or three hours if it is done longhand.

We have found from numerous installations that the temperatures which we actually obtain in practice coincide very closely to the design temperatures which we derive from the use of these curves.

To efficiently use a checker system you must use all the flue passages through the system. Most everyone will agree that in the case of primary checkers you very definitely have channeling. In other words the hot gases will go down through one section of the checker chamber and the incoming air will come back through another section of this same regenerator.

In the design of the secondary checkers for our furnace system we use a high enough velocity through these secondaries so that we have a definite draft loss which insures that the entire area of these checkers will be used for the passage of gases and air at all times. In our design we keep the entering velocity of the outgoing flue gases at the base of the secondary checkers to at least 20 fps actual velocity. In this manner we always obtain relatively even distribution. This velocity, of course, will vary with the length of the secondary checkers, because the length determines the draft loss through the checker chamber.

We have secondary checkers ranging from a length of about 15 ft to a length of 40 ft.

The entering gas temperature on the 15-ft checkers averages approximately 1050 F while the entering gas temperatures on the 40-ft checkers averages between 1800 and 1900 F. Both checkers exhaust the flue gases to the atmosphere at an average temperature of 800 to 850 F. We believe that this exhaust gas temperature is at about the most economical point. Of course, we can design for lower temperature if that is desirable. The glass industry prefers exhaust gas temperature in the neighborhood of 400 to 500 F.

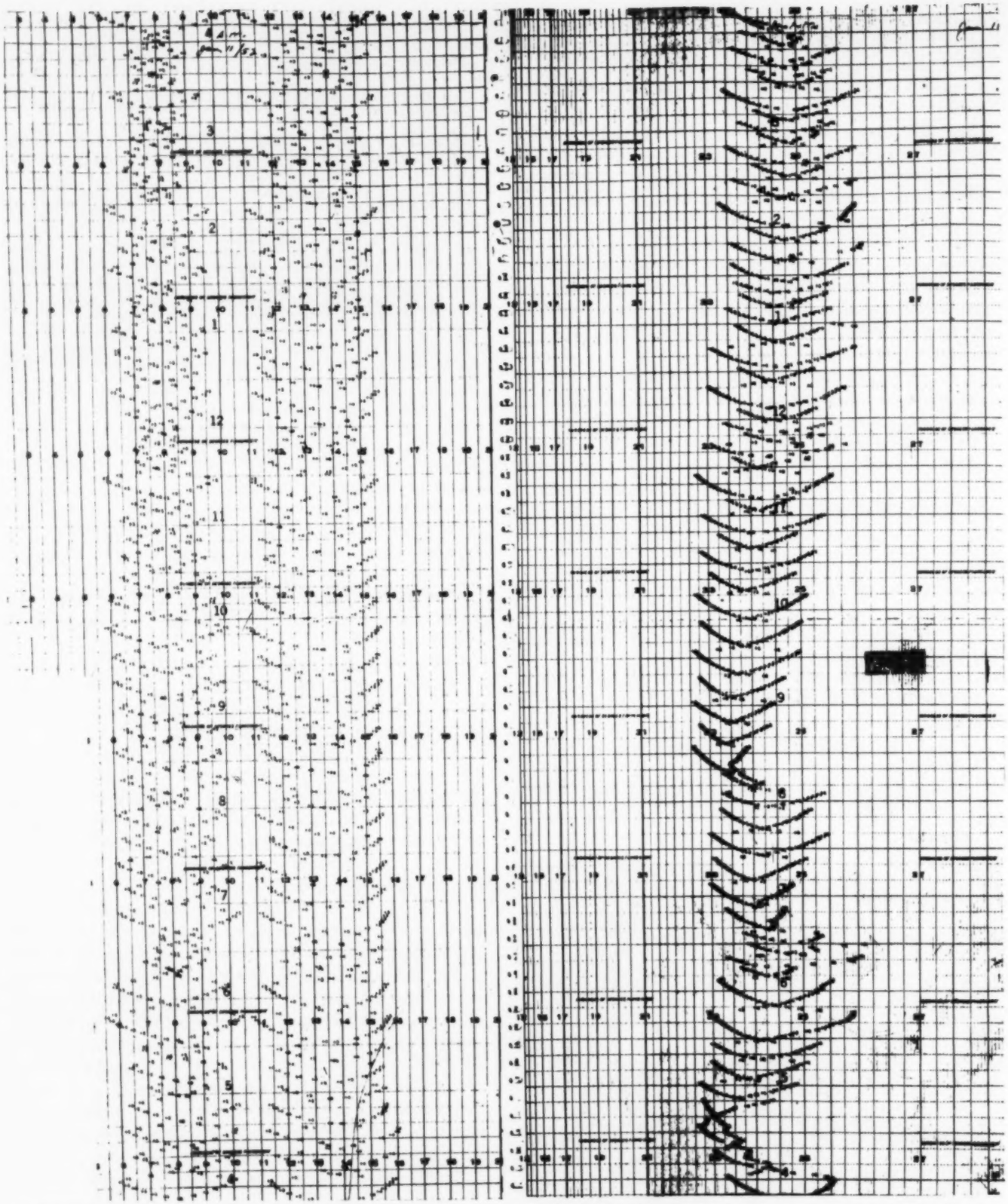


Figure 9 — Temperatures are given on top of primary checkers during the duration of making a heat for 170-ton furnace operating on cold metal.

By the use of secondary checkers we also increase the performance of the primary checkers, due to the fact, that the air entering the primary checkers from the secondary checkers will be much hotter than the air entering the bottom of the primary checkers where no secondary checkers are used. For instance, in a furnace without secondary checkers where the combustion air enters through a saucer in the flue system, the temperature of the air as it enters the bottom of the main checkers is probably not over 200 F, while in a furnace with our system with secondary checkers, the air entering the base of the primary checkers from the secondary checkers will be in the neighborhood of 1000 to 1200 F. This means that its volume will be approximately 2½

times that of the furnace without secondaries, which results in better air distribution through the primary checkers and therefore a greater heat transfer rate, due to the use of practically all of the primary checker chamber.

Figure 5 shows a cross section through a secondary checker. The checkers are laid basket weave with straight flues which, of course, require no special brick shapes. They are supported on rider walls and arches as shown in Figure 6. Figure 6 also shows an elevation through the checker chamber with a 40 ft length of travel.

Figure 7 shows a photograph of this furnace system with 40-ft checkers. In this instance the bottom of the flues leading to the secondary checkers are at ground level as can be seen. This gives ready access to the flues and the bases of the two secondary regenerators for cleaning out flue dust and dirt.

Figure 8 shows such a furnace system where the bulk of the secondary checkers are located below ground level.

Figure 9 shows the temperatures on top of the primary checkers, between the primary and secondary checkers and leaving the top of the secondaries and being exhausted to the atmosphere. This temperature record is from the start of the heat until the time it was tapped and is approximately 10 hours and 15 minutes. Please note that the average temperature of the checker brick at the start charge of the heat is approximately 2400 F and that when the heat was tapped it was approximately 2500 F, with a low point of about 2250 F prior to reversal. These temperatures, of course, are brick temperatures and not actual flowing air temperatures.

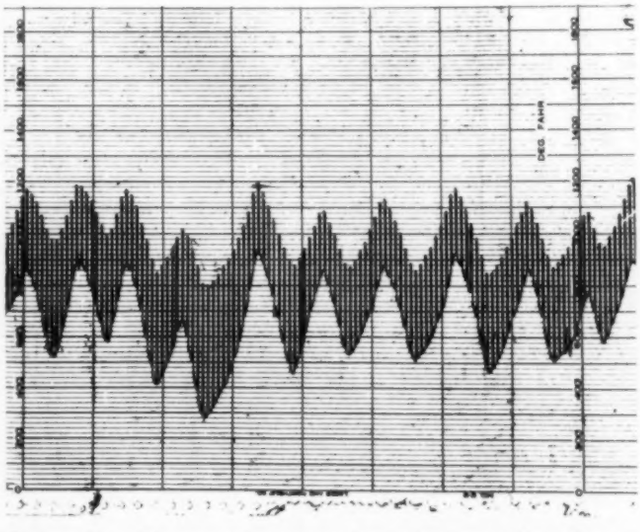


Figure 10 — Temperatures are shown between the primary and secondary checkers for a 550-ton furnace having a 15-ft depth of secondary checkers.

This is a furnace operating entirely on cold metal and taps approximately 170 tons.

Figure 10 shows temperatures between the primary and secondary checkers of a furnace with 15 ft depth of secondary checkers. This furnace taps 550 tons with a hot metal charge.

We have taken some flowing air temperatures with an aspirating couple. Figure 11 shows some of the results that were obtained on one heat. Unfortunately we were not able to obtain temperatures on every reversal but we did obtain temperatures at the beginning of charge and during the charging period, along towards the middle of the heat, and during the last three hours of the heat. It is interesting to note that the minimum temperature recorded was in the neighborhood of 2135 F and the maximum was on the order of 2440 F. The average temperature difference during reversals, that is, from start of reversal to start of the next reversal was less than 100 F. In one or two instances this temperature drop was in the neighborhood of 180 F.

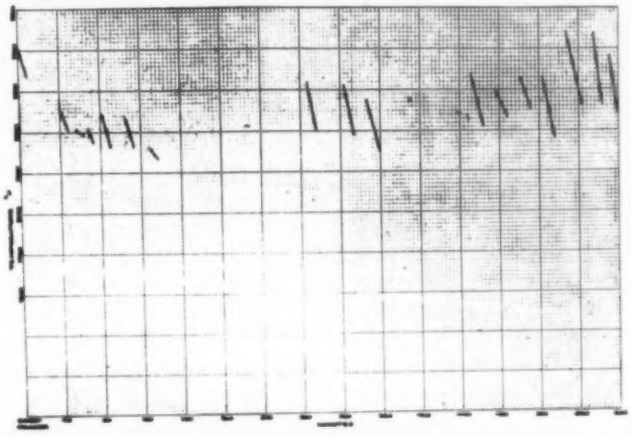


Figure 11 — These air flow temperatures were taken with an aspirating couple.

We believe that the operation of an open hearth furnace is very much dependent on as high combustion air preheat temperatures as it is possible to obtain during the meltdown period, and that the hotter this air preheat is at this time, the faster the furnace will operate. Near the end of the heat we do not feel that the added air preheat helps nearly as much, although it is just as desirable from a fuel economy standpoint, but does not contribute nearly as much as high temperature during charging.

Figure 12 shows the actual flowing air temperature records from a section of of the potentiometer chart which was obtained during the charging period of one heat. On top of the actual record has been superimposed the checker brick temperatures as obtained from the potentiometer recorder in constant use on this furnace. Notice that the maximum temperature of the checker brick as shown by this potentiometer was 2593 F and the minimum was 2280 F.

The instrument used for recording the actual air temperature was a bath temperature recorder with a high speed chart and each division on this chart denotes one minute of time.

Figure 13 shows what we believe to be a new idea in the construction of an open hearth furnace as far as regenerators are concerned. There are no regenerator chambers in the basement of the open hearth building as the primary regenerators are incorporated in the base of the ejector along with the secondary regenerators. A flue from the normal fantail arch connects from this point to the bottom of the primary regenerator in the base of the ejector, and then as can be seen the base changes in diameter and the secondary regenerators are placed above in the base of the ejector.

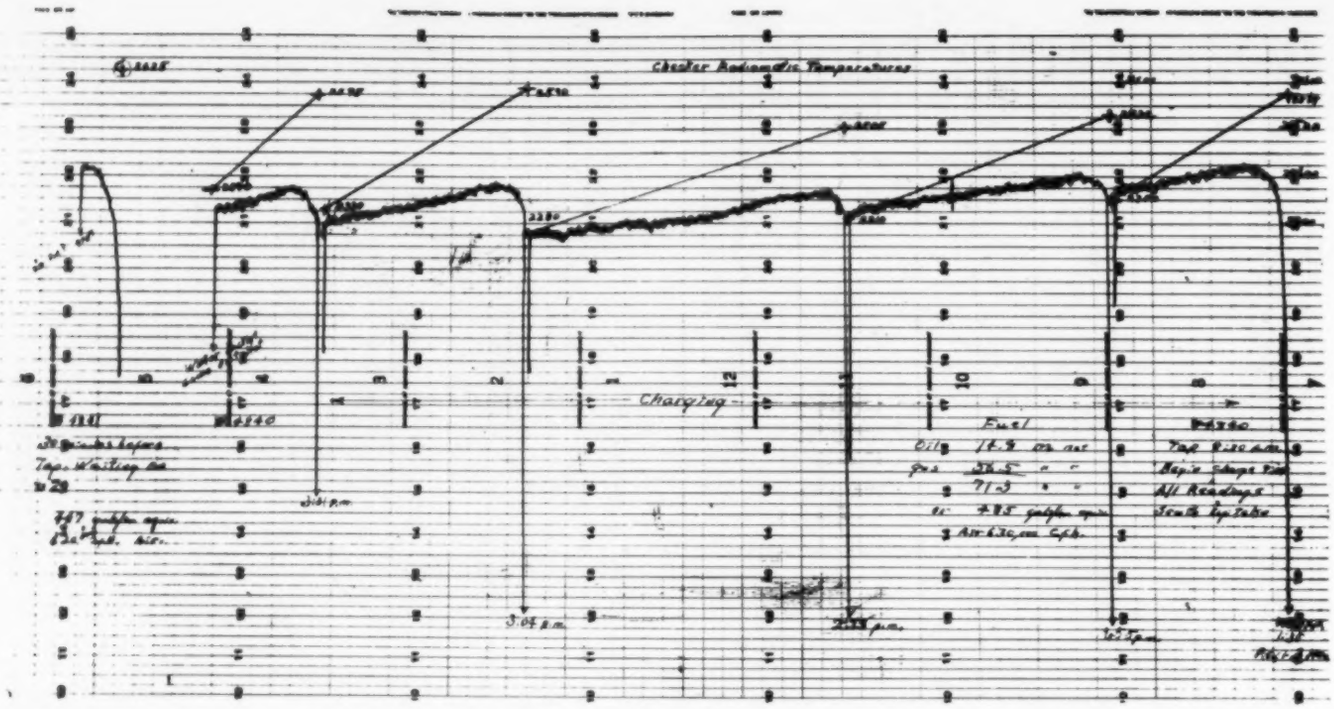
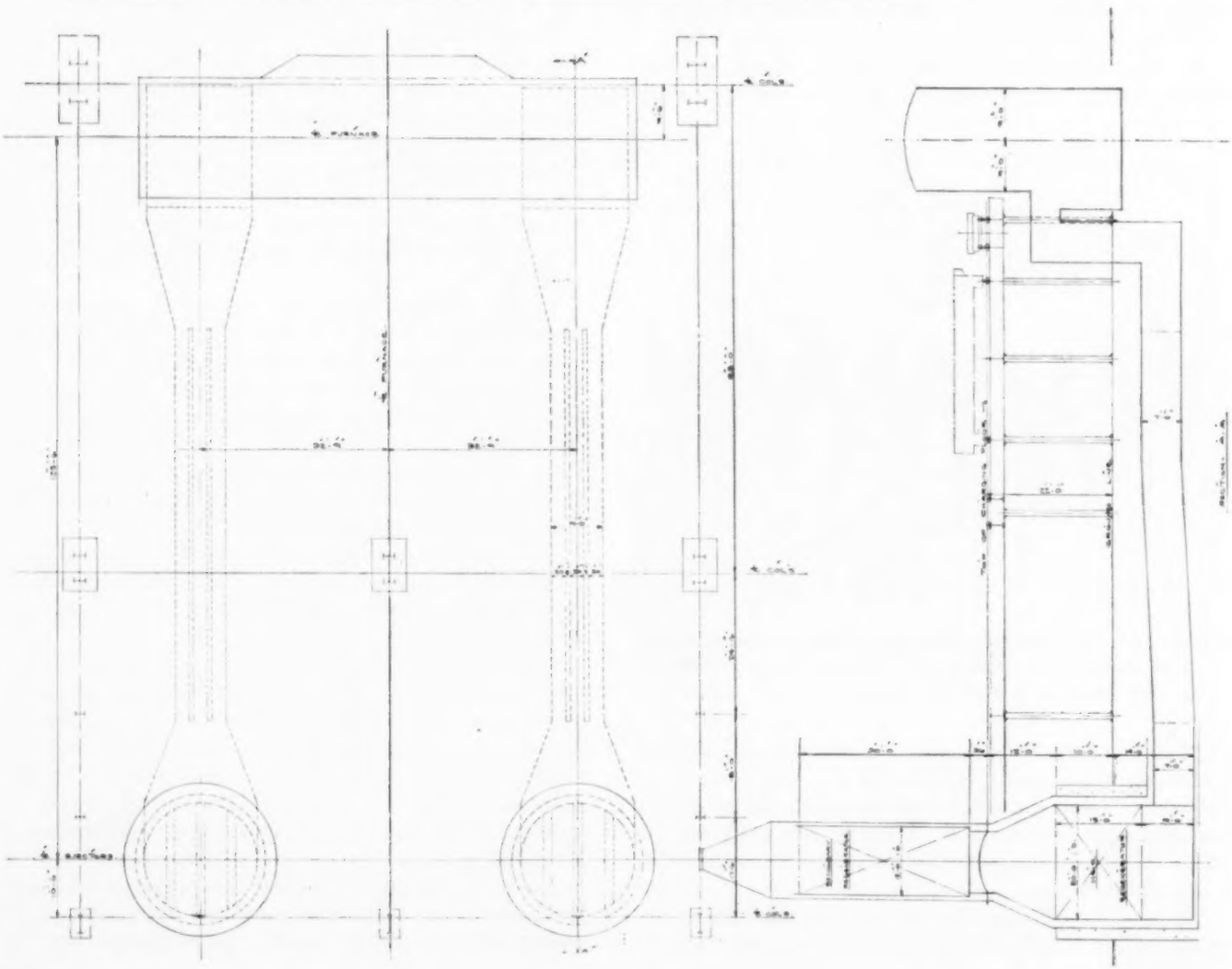


Figure 12 — Chart shows air flow temperatures during charging period and on this is superimposed checker brick temperatures.

Figure 13 — In this design, there are no regenerator chambers in the basement of the open hearth building. The base changes in diameter in the secondary regenerators above the base of the ejector.



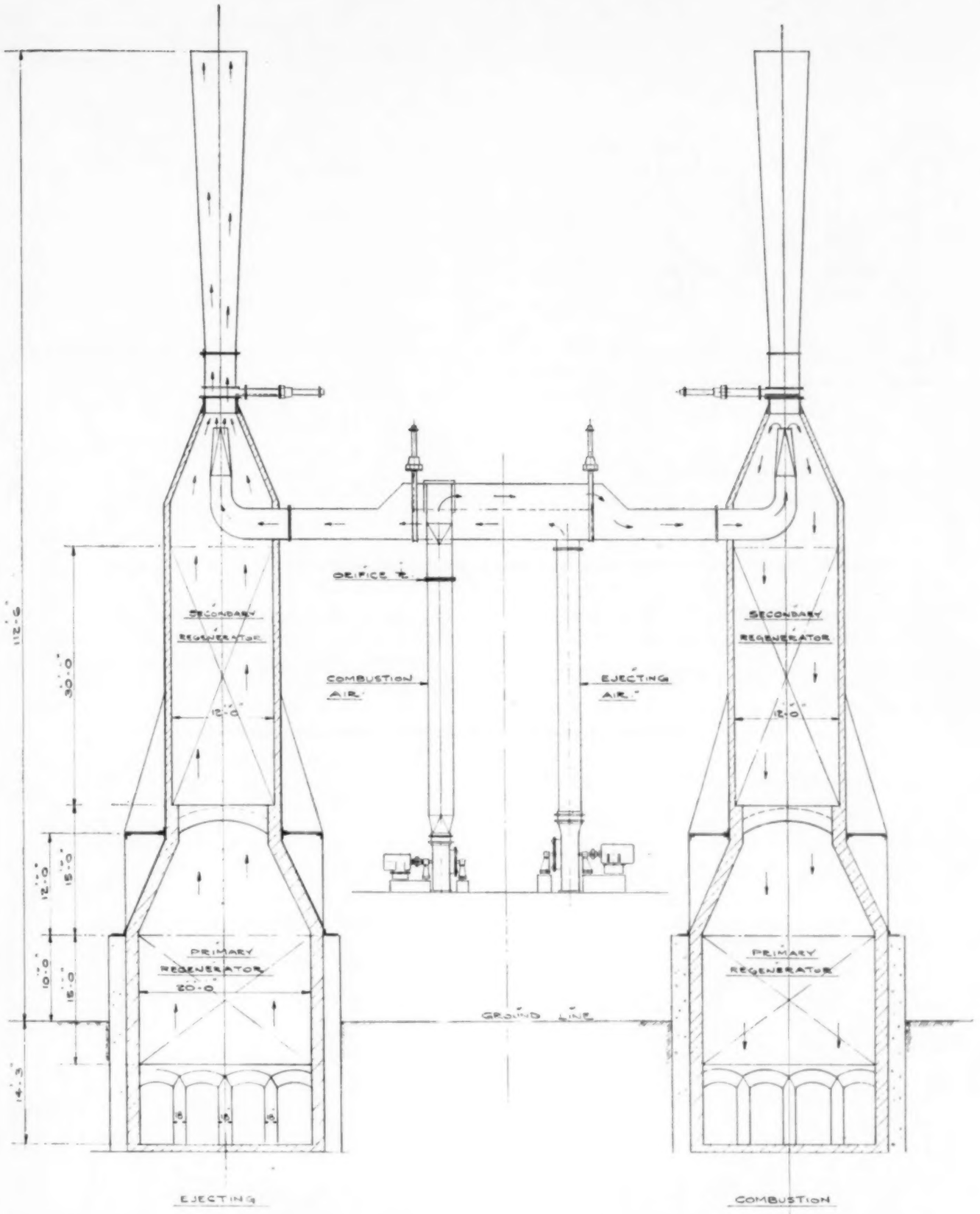


Figure 14 — General arrangement of system with secondary checkers having all checker work in the bases of the two ejectors are shown in this layout.

This construction allows for the removal of the primary checkers without disturbing the secondary checker brick. Note in the plan view that we have indicated two long walls in the flues which are merely in there as heat exchanging surfaces. We believe with flue gases leaving the slag pocket at a temperature of 2800 to 2900 F that we should have a drop of 200 to 300 F by the time the gases reach the bottom of the primary checkers.

This design has been discussed with the brick indus-

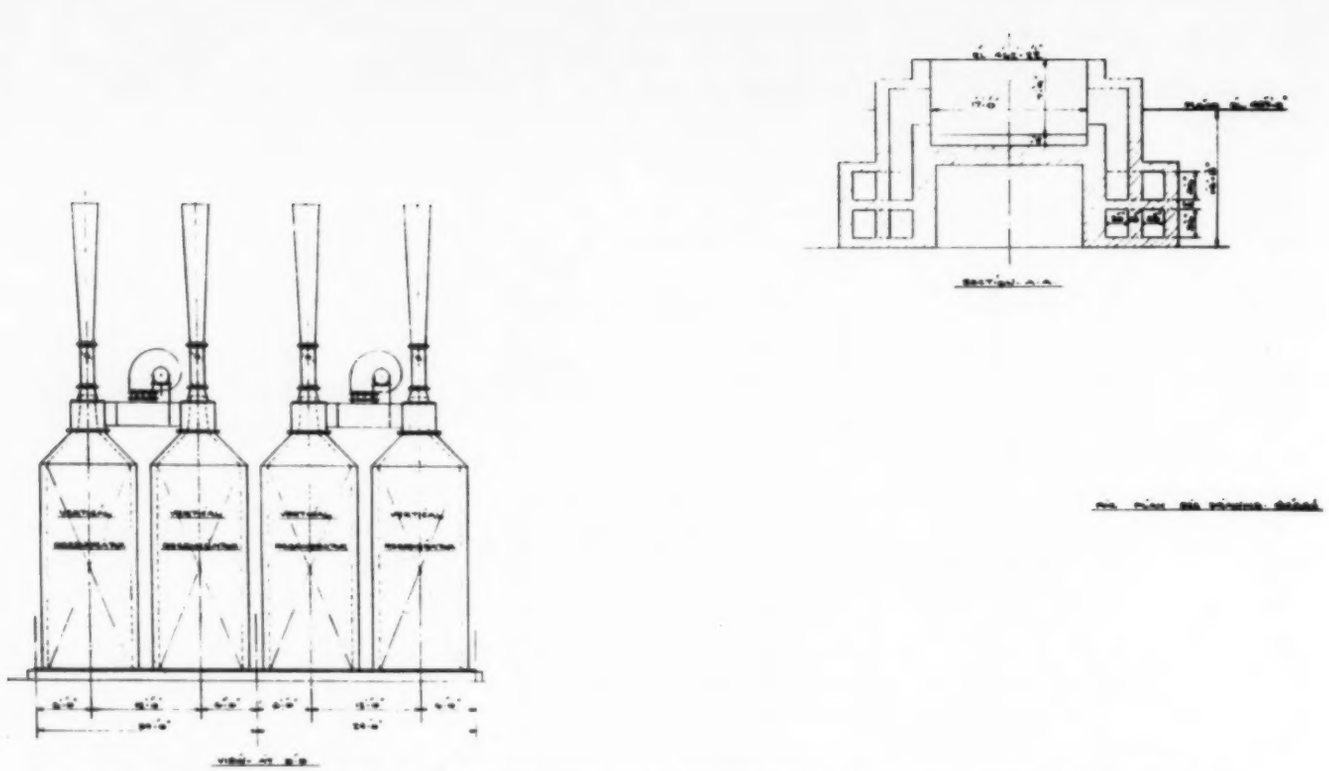
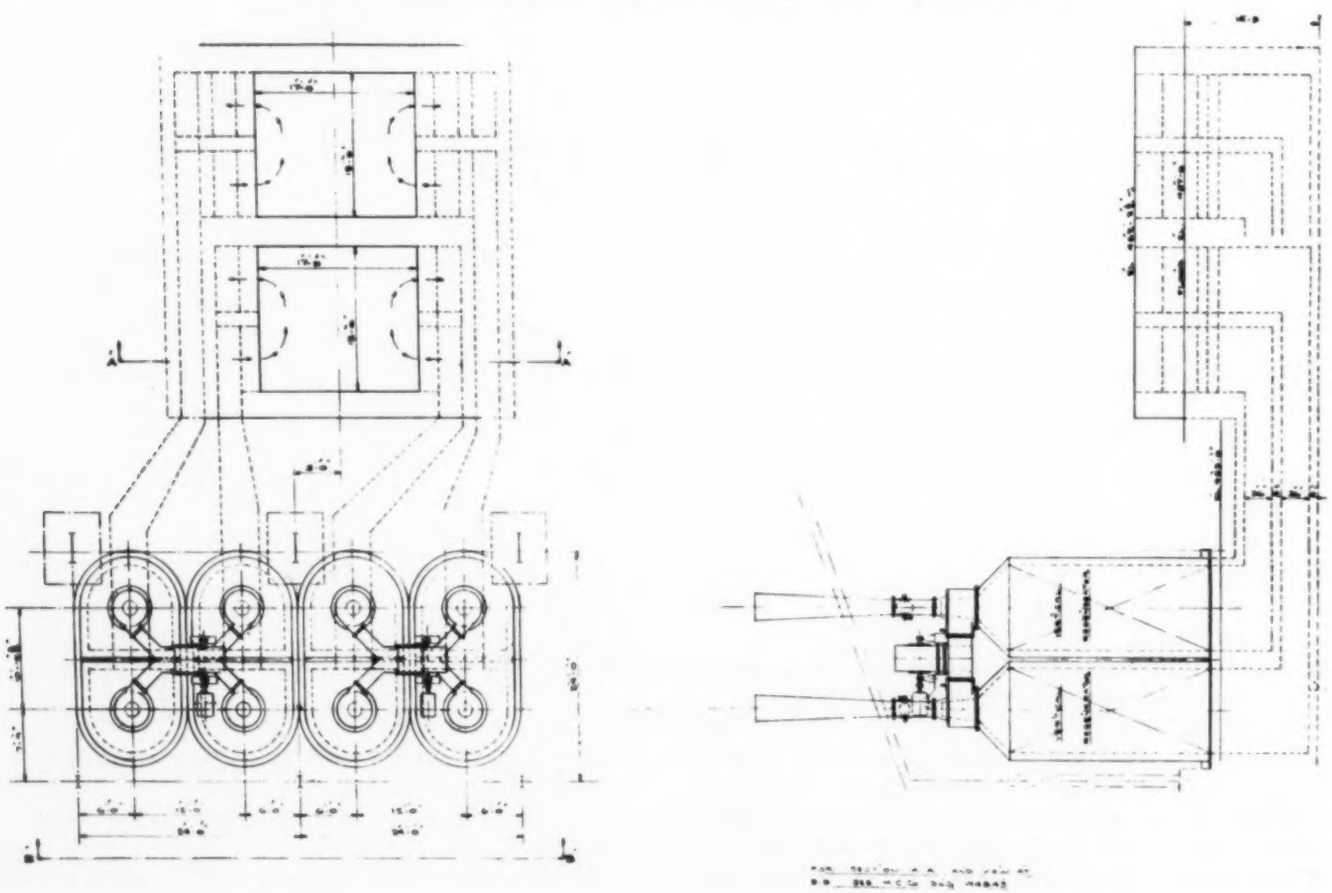


Figure 15 — Regenerator of soaking pits also used a layout with checkers in the bases of the ejectors.

try and they have assured us that there will be no trouble in supporting the checker brick work as we have indicated.

There are many advantages to this design of a furnace, one of which is the checker chamber can be so designed so that the entire chamber will be used for the exchange of heat between the flue gases and the combustion air.

Figure 16 — Additional details of layout shown in Figure 15 are given here.



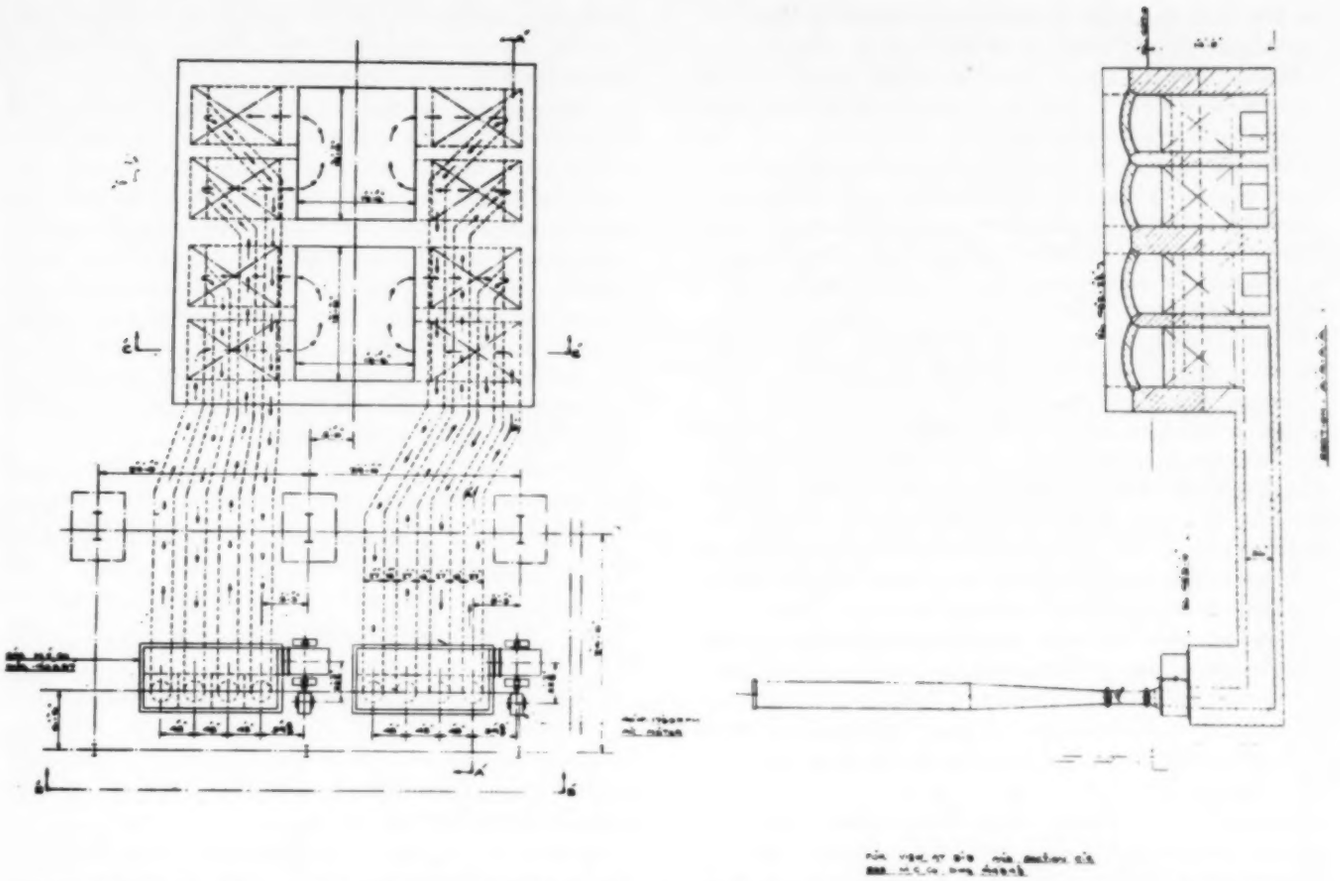


Figure 17 — When these pits were modified, the center wall was removed from between each two adjacent holes and a large cover was built to cover the enlarged hole.

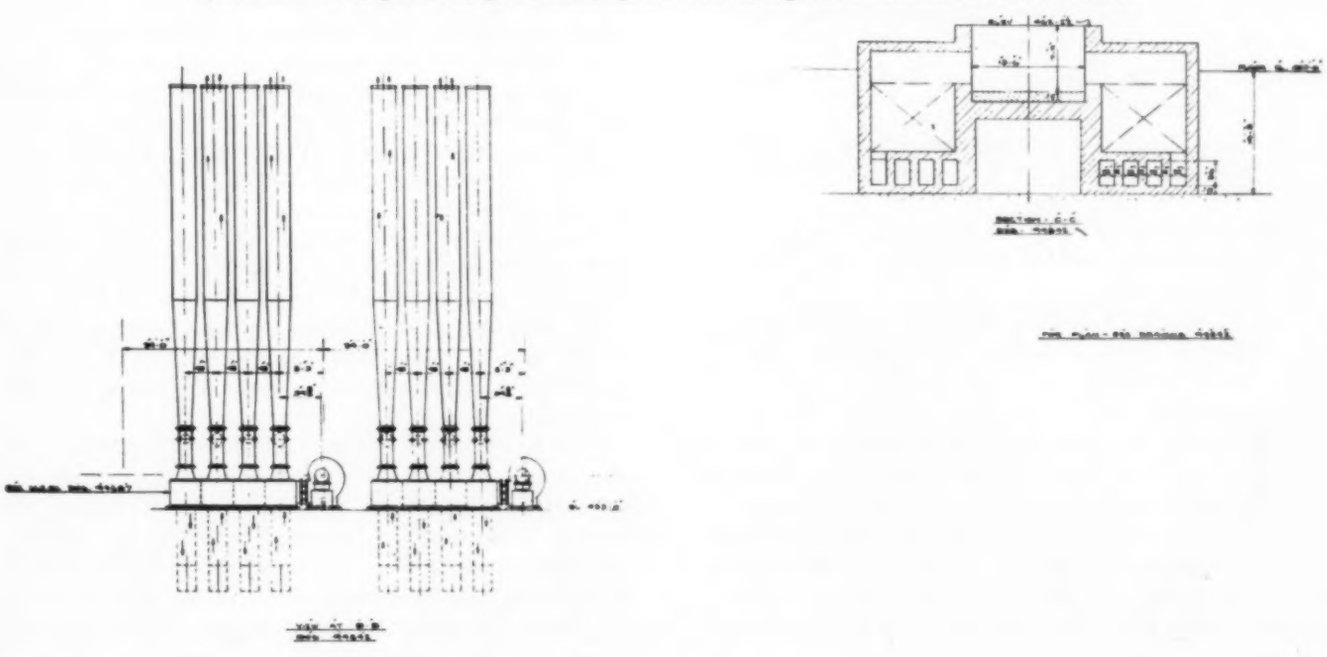
Second, we believe that this construction will be less costly than the present method of constructing the primary checker chambers.

Third, the leakage in these checker chambers will be practically zero.

Fourth, there should not be nearly as much dirt carried over to the checkers as is now the case with the primary checkers built very close to the slag pockets and with only the short fantail connecting the two.

Fifth, the brick masons will appreciate all the added storage space which will be available in the average open hearth basement due to the fact that the space where the primary checkers normally are, will now all be available for brick storage, that is, provided they

Figure 18 — Change in design allowed operator to charge an increased amount of steel.



can convince the open hearth superintendent that this space should be allotted to them.

The dimensions shown on this sketch are actual dimensions of a shop which was constructed recently and which has 225-ton furnaces in it.

Figure 14 shows the general arrangement of our system with all the checker work in the bases of the two ejectors. This system with checkers in the bases of each of the ejectors is not confined to melting furnaces, such as open hearths or glass tanks, but may be adapted to heating furnaces as well.

Figures 15 and 16 show the layout of a furnace system with checkers in the bases of the ejectors as applied to regenerative soaking pits.

The method of firing these soaking pits is rather unique and was developed by the Sparrows Point plant of the Bethlehem Steel Corp., and their original method of using the system is shown in Figures 17 and 18. Originally each row of their regenerative pits consisted of four small holes with the system furnishing combustion air and draft to each hole individually. The center wall was removed between each two adjacent holes and a large cover built to cover this enlarged hole and the pits fired as indicated in Figure 15. This method of construction allowed them to charge an increased amount of steel, which of course resulted in higher tons per hour and lower fuel per ton.

This method of firing has been applied in another steel plant to two rows at the present time, a third one is being installed, and three more are to be installed as fast as the change can be made.

The advantage of the use of checkers in the bases of the ejectors as shown in Figure 15 and Figure 16 is that a higher air preheat temperature will be obtained due to the 20-ft depth of checkers. Also a much larger cross section area of each hole will allow for setting a greater tonnage of ingots in the same building space as is required when these checkers are built adjacent to the pits as is normally done. The additional pit area in this instance amounts to 53 sq ft per hole or 106 sq ft for the two holes. This could be very readily increased to a greater amount and, of course, is determined by the size of ingots which are to be set.

Each of the four holes as originally designed were to be 13 ft 6 in. x 6 ft 0 in. giving a total area of 324 sq ft.

The two holes as shown in Figure 15 are 15 ft 0 in. x 17 ft 0 in. each which gives a total area of 510 sq ft. This is an increase of 186 sq ft or slightly better than 57 per cent without an increase in the size of the pit building.

The system with checkers in the bases of the ejectors can very readily be applied to regenerative side door heating furnaces as well as slab furnaces, billet furnaces, etc., in fact, any furnace that requires or uses preheated combustion air.

DISCUSSION

PRESENTED BY

R. E. CRAIG, JR., Phoenix Iron and Steel Co., Phoenixville, Pa.

LEN SHARP, Fuel Engineer, Keystone Steel and Wire Co., Peoria, Ill.

RUSSELL FAYLES, Superintendent of Refractories and Fuels, Lukens Steel Co., Coatesville, Pa.

F. HARRY SPIESS, Fuel Engineer, Alan Wood Steel Co., Conshohocken, Pa.

C. E. DUFFY, Fuel Engineer, Bethlehem Steel Co., Sparrows Point, Md.

H. C. HENCHEN, Combustion Engineer, Fuel Dept., Bethlehem Steel Co., Sparrows Point, Md.

JACK E. WEBER, General Supervisor Fuels and Instruments, United States Steel Corp., Fairless Hills, Pa.

H. S. HALL, Assistant Manager, Combustion Control Dept., Morgan Construction Co., Worcester, Mass.

R. E. Craig, Jr.: Late in 1952, we attached such a system to our open hearth furnace, which we thought had the most inadequate primary checker space—namely our No. 2, which is a 150-ton furnace, all cold-charge, burning only Bunker C oil. The system has 40-ft of secondary checker space, all above ground.

I gathered a little data comparing the performance of the furnace after we attached the system, to a period comparable in charging conditions, in 1952. I would like to preface this small amount of data by saying that we expected from the new system about a 15 per cent increase in overall furnace efficiency. However, due to the fact that we had very inadequate primary checker space and also a furnace whose overall length was only about 64 ft, we did not quite attain that goal. Here are some of the most significant figures that I have. Our average heat time, after attaching the system, was decreased by 11½ per cent. Average net tons per hour increased by 11 per cent, and to indicate that we were not cheating by making heavier heats, the average weight of the heats was 2 per cent lower. Gallons of oil per net ton decreased by 11 per cent.

Some of the temperatures that we have obtained with the system are as follows:

With a 5 to 8 minute checker reversal period, a low of 2200 and a high of 2450 F, using only the standard checker brick.

Temperatures at the base of the stack run around 1800 or 1900 F, and the temperatures at the top of the secondary checkers are between 800 and 900 F.

We plan when the next opportunity presents itself to enlarge our furnace upstairs so that we will be able to burn 500 to 550 gallons per hour. We are at present averaging 400 to 450.

Glen Sharp: We have such a combustion control on one furnace. We like the system, but in all honesty are not getting as much from the furnace as we feel we should. However, the furnace does hold the weekly production record while its monthly record is almost exactly the record average of the shop. It should be mentioned that these records were established without

benefit of metallurgical oxygen, whereas all other standing shop records were influenced by the use of this item in amounts which sufficed to increase production by about one and one half tons per furnace hour.

In actual figures the furnace was, for the calendar year just past, 3.4 per cent better than the remainder of the shop production-wise, but only 0.4 per cent better on fuel. While we are neither content nor displeased with production we are less than happy about the fuel consumption. Even though stack temperatures average, if anything, slightly less than the figure previously mentioned as existing elsewhere, other losses are high. As a time function the sensible heat loss, per ton of product, tends to be reduced in the case of fast heats. Because the furnace is fast-melting, by virtue of well-sustained preheat temperatures, it makes more than its share of such heats and these compensate for abnormal losses sustained on slow-working and delay heats.

Evidence suggests that the greater losses occur between furnace and regenerators. While preheat temperatures are satisfactory, simultaneous measurements with aspirated thermocouples reveal little or no gain between checker bridgewall and floor level. Simultaneous gas analyses made at these same points indicate that the oxygen content of the flue gas is increased by 4 per cent in passing from floor level to regenerator. This means that in addition to those losses accepted as normal for basic ends, we have, in this instance, the extra handicap of admitting the majority of the total excess air at the worst possible points.

None of this should be construed as a condemnation of either basic brick or suspended construction as such. Both have important merits, else they would not be used. We do expect to find methods of sealing which will permit the furnace to deliver the performance of which it is inherently capable.

To comment upon the excellent paper just heard, the most interesting item is perhaps Figure 13, showing the completely tanked regenerator. Such a system has many attractive features: flexibility of location, vertical designing freedom, the opportunity to properly distribute the regenerative surface along the axis of flow, a cross-section compatible with natural flow patterns, and a minimal loss-surface. As a bonus there are the dummy walls in the connecting flues. These can act as a cushion or "rougher" pass between furnace and regenerator proper. As such they can protect the tenderly constructed checkerwork and by compensating for our gradually diminishing uptake areas, increase the level of preheat available from the total system.

R. Russell Fayles: I did not expect to be called upon. The only remarks I have are a few questions. First, during the paper you mentioned some work done on the checker brick sizes. It was mentioned but no further indications of what you found were disclosed. I would like to hear more about that.

Secondly, I would like to know, on whatever basis you may have it, figures on the cost for power on these induced-draft fan installations, and what you estimate the loss of steam credit might be to the open hearth through such an installation.

Thirdly, I would like to get information on what increase in pre-heated air temperature you might expect per hundred degrees increase in pre-heat air temperature through the tank checkers. I realize it is going to vary somewhat from furnace to furnace and installation to installation. However, you illustrated an example where you have 200 F air prior to entry into the primary checkers and you have 1000 to 1200 F air at the same point when using tank checkers. I would like to know how much increase in pre-heat air you might expect at the bridge wall with such a change in inlet air temperature.

My last question has to do with what you might consider to be a maximum attainable flowing air temperature in the checkers. One man at Sparrows Point has expressed the opinion that there is an upper temperature limit to which checker brick can be subjected, not because of the characteristics of the checker bricks themselves, but rather the chemical constituents of the debris which deposits on them. In other words, they have determined an upper limit of about 2400 F for the deposits which accrue on checker brick, and if they go above that, the deposits become molten and actually disintegrate the bricks themselves.

I will finish my remarks with a couple of observations on your somewhat novel furnace design in which you have no primary checkers, to say that there are two other things which appear to me to be attributes of such a design. No. 1, would be the probable elimination of surface water difficulties which are always a problem in regenerator systems on open hearth furnaces, and secondly, that with proper layout, debris and dirt removal could be improved immeasurably over what we find in our present day furnaces.

F. Harry Spiess: It became evident that considerable repair and rebuild expenditures would be required on our No. 4 open hearth furnace. The structural and mechanical conditions necessitated a complete rebuild from the furnace, through the regenerators, and including the stack. This furnace was originally built for 50 gross tons, and later the physical dimensions of the furnace were changed to accommodate 110 gross tons by increasing the length of pan and some changes to regenerator roofs and end walls.

In the light of these conditions, it was decided to investigate the possibility of completely modernizing the furnace, and in particular the checker chambers, stack, and flue arrangements, with also a metallurgical improvement of the furnace proper.

Several schemes and designs were proposed but flue arrangements and checker sizes were never up to our desired specifications, because of lack of adequate room in the basement for larger checker chambers. Also, the space between the building and the scrap yard did not allow enough room for proper valving, flue and stack arrangements. However, your stack principle, with additional checkers in the base of the stack and reversal mechanism located in an elevated position gave us the desired results.

The furnace was installed and put into operation in May, 1951. The layout of this equipment in our space gave us ideal conditions for the application of furnace pressure, combustion air, and checker temperature controls which we were unable to get before. In addi-

tion to this, we were able to increase our checker brick volume and in effect, get a two pass checker system the main regenerator chamber acting as the primary checkers, and the stack acting as the secondary checker chamber.

Our heating surface was increased by 42 per cent. The heat recovery from the checker system shows approximately 2350 F top checker temperature of the primary checkers, 1700 F at the bottom of the primary checkers, and 800 F at the top of the secondary checkers. This indicates a pick-up in the heat recovery of the secondary checker system, which Mr. Hall covered thoroughly in his paper.

This furnace has consistently operated with a more efficient fuel and production rate than other furnaces in the shop, and in additon, the maintenance of brick work has decreased.

The fuel rate on this furnace shows a 10 to 12 per cent reduction in gallons per ton and an increase of 12 to 15 per cent in production of tons per hour, over other furnaces in our shop. In addition, there has been an approximate 20 per cent increase in roof life for the furnace campaign.

I would like to ask Mr. Hall if, with his proposed furnace design, as shown on Figure 14; it would be possible to reduce in size or perhaps eliminate the ejector fan on this stack?

C. E. Duffy: An overall velocity of 30 fps through the checkers and flues of an open hearth furnace seems high, did I understand your statement correctly?

Do you have any data on how thick a checker brick should be to give maximum heat transfer and sufficient strength?

In your proposed open hearth primary checker chamber do you feel that the brick at the temperature that they will be exposed to will be strong enough to support the load that they must carry? Would it be practical to bring the hot gases into the primary checkers at the top instead of in the bottom?

H. C. Henchen: Some people have expressed interest in our rather unique soaking pit which Mr. Hall described. For the benefit of those who have been asking questions, I have a few of the figures they might be interested in.

The original which we eventually converted, was heating about 15,000 tons of steel a month. By removing the division wall and adding the two-position automatic controls—of course they are very simple and elementary—we increased tonnage from 15,000 tons a month to better than 21,000 tons a month. The tonnage increase was 35 per cent or better; whereas the hearth area increase was only 20 per cent. We attribute this to several factors: One is the rather unique round-the-circle system of firing, which Mr. Hall described. Another is the fact that we can charge quite a bit more steel per square foot of pit, and thereby increase our output, and of course, a third is the fact that we have a rather large amount of port area exposed to more ingots and we thereby get efficient heat transfer between the combustion ports and the pit itself.

We were pleased at the output of these soaking pits and at the time, we thought that we had a pit which would heat more tons per square foot of the building than any other pit in the country. However, with Mr. Hall's new tank checker we feel sure that when the pit proper utilizes the space we now take up for our primary checkers, our pit performance based on square foot of building area will be low compared to his newer designs.

Jack E. Weber: The question of air pre-heat and how you obtain it can be compared somewhat to a speech called "Acres of Diamonds." We should not forget that there are several things, which you can do to improve what you already have if you will only look under foot. I have itemized some of them as follows:

1. Make sure that you are ordering and getting the best possible checker brick that you can buy. Believe me there is a difference.
2. Secondly, make sure the checker brick size and layout gives you the maximum possibility of exposed surface.
3. See that you thoroughly check the possibilities of redesigning your fantail and regenerator roof layouts, because the depth of checkers in many cases can be increased considerably by making certain suspended type changes.
4. Have a good program of checker cleaning. Investigate every possible chemical type of cleaner in addition to the one Mr. Hall mentioned earlier —making sure air leakage is held to a minimum.

H. S. Hall: In answer to Mr. Fayles' first question, Dr. Paschkis gave us the following correction factors to be used for various half thicknesses of brick as follows:

Half thickness, in.	Correction factors for A
0.75	1.04
1.25	1.13
1.75	1.20
3.00	1.23
3.50	1.21

The correction factor for "A" as listed in the above tabulation is used after "A" is determined from the nomograph using the values of L, t and V_G.

In answer to the second question, most every open hearth in operation at the present time has a combustion-air fan and our combustion air fan does not take any more power than the combustion-air fans that are used on an ordinary open hearth furnace. The ejection-air fan will take considerably less power than the waste heat boiler fans in use today on modern open hearth furnaces. I believe at the present time that the larger open hearth furnaces with capacities of approximately 300 tons per heat have 200 to 250-hp motors driving the boiler fans and using a good bit of this available horsepower a considerable portion of the time.

We recently had occasion to take power readings on two 300-ton furnaces with these systems and secondary checkers, and the power reading was 98 horsepower at that time. The furnace was burning 125,000,000 Btu per hour and the doors were up and the furnace was being charged.

After the furnace was charged and the doors closed, the variable inlet vanes on the ejection-air fans closed to about 20 per cent open position and the ejection-air fan motors at that time were requiring in the neighborhood of 48 and 50 horsepower.

On the 550-ton open hearth furnaces equipped with our system with secondary checkers, we have 100-hp

motors driving these ejection-air fans. A test was run on the horsepower required by this ejection-air fan and over a period of approximately one month the maximum horsepower required was 88 horsepower, and the average for the month was about 55 horsepower. I believe you will find that much less than any induced draft fan on a boiler even when the boiler is clean.

There is another advantage inherent with our system and that is that the ejection-air fan handles only cold air and not the hot gases as is the case with waste heat boiler installations.

In answer to your third question regarding what increase in preheated air temperature you might expect per 100 F increase in preheat air temperature through the tank checkers, we will make the following assumptions:

Assume that you have a primary regenerator that will give 2100 F air coming from the top of this regenerator, and then you install our system with secondary checkers and the air leaving the secondary checkers is at 800 F. The total air temperature leaving the top of the primary checkers after going through both checker chambers will be 2530 F. That is, of course, average temperature and is based on 10-minute reversal time. The temperature of the flue gases leaving the top of the secondary checkers will be 720 F. The above temperatures are all based on the flue gas temperature entering the top of the primary checkers of 2800 F.

Of course you realize the higher the air preheat temperature becomes, or to put it another way the closer the air preheat temperature comes to the brick work temperature or the flue gas temperature entering the top of the primary checker, the less heat transfer takes place.

With regard to loss of steam credit on an open hearth through the installation of our system, that is a question I believe can be argued a number of different ways. There are certain methods of figuring steam credit as you no doubt know, and your accounting department no doubt has as much to do with the dollar value of steam credit that the open hearth receives as anyone. However, to explore steam credit and steam produced by a waste heat boiler a little further, let us take the same furnace that you suggested where we will get 2100 F preheated air temperature without the secondary checkers in the bases of the ejectors. You will find that the gas temperature leaving the primary checkers will average about 1300 F. A modern waste heat boiler will reduce the temperature of these gases to 550 F which is I believe a good average gas temperature from this type boiler.

With the checkers as we assumed above, we would not have much more than 30 per cent excess air in the flue gases coming to the checker chambers, which would give us a flue gas analysis of approximately 12½ per cent CO_2 and 5 per cent oxygen, and in this calculation I am not assuming any water vapor in the flue gases. With 30 per cent excess air in the flue gases coming to the checkers, you will have about 1800 cubic feet of products of combustion for every gallon of fuel oil burned, and at a flue gas temperature of 1300 F you will have 45,273 Btu in the flue gas at 1300 F for every gallon of oil burned. This same amount of flue gas we will assume passes through the boiler with no leakage into the gas stream or boiler whatsoever, and emerges at 550 F. This would mean that 29,068 Btu in the flue gas is converted to steam and does not allow for any heat radiation from the boiler, the flues leading to the boiler or air leakage into the boiler setting, which would dilute the flue gas and cause a drop in temperature.

I am assuming that your boiler would operate at 290 psig with 100 F superheat for a total steam temperature of 519 F. The total heat per pound of steam as stated above is 1268.7 Btu. We are assuming that your feed water temperature would be 212 F, which would account for 180 Btu per pound, leaving 1088.7 Btu required to produce one pound of steam at 290 psig with 100 F superheat. Divide 29,068 by 1088.7 and you find that you would produce 26.7 pounds of steam per gallon of oil burned under the conditions stated above, which are perfect. If you were burning 550 gallons of oil per hour and your flue gases were the same condition as stated above, you would then produce 15,240 pounds of steam per hour. If you are burning 400 gallons of oil per hour you would produce 11,080 pounds of steam per hour, and for an average oil consumption of 500 gal of oil per hour over an entire heat you would produce 13,850 pounds of steam per hour.

This steam will be credited to the open hearth at some predetermined figure, no doubt, and from it you must subtract the cost of producing this steam. This cost must include operating labor, maintenance labor, maintenance costs of the boilers, the steam lines, the water lines, feed water pumps, feed water heaters, and, of course the boiler brickwork, fans, and all the attendant auxiliaries which are necessary to operate a waste heat boiler. This operating cost should also contain either steam or power required to drive the feed water pumps, the power required to drive the 200 or 250 horsepower induced draft fans, the steam or air used for blowing the boiler and, of course, the amortization cost of the waster heat boiler.

With the above figures you can then determine the approximate cost of steam generated in waste heat boilers and determine how much credit the open hearth should receive. The question you must then answer is —are you going to make steel or steam.

Regarding Mr. Harry Spiess' question, would it be possible to reduce in size or perhaps eliminate the ejector fan on the new design open hearth. There is no doubt that the draft requirements would be reduced somewhat, but I do not think it would be possible to entirely eliminate the ejector fan on this design. I believe that on the first installation it would be well to use our present design calculations for the ejection-air fan and if experience shows that this fan could be reduced in size, then on subsequent installations this factor could be taken into acount.

With regard to Mr. C. E. Duffy's first question, my statement might be somewhat misleading. We assume that the average velocity through the downtakes, through the fantails, through the checker work, flues, etc. would be approximately 30 fps. At certain points we have higher velocities and at certain points we have lower velocities, but it seemed to us that 30 fps was an average overall velocity of the gases through the entire

regenerative system. We believe that the length of travel of 150 feet is average for a modern, large, open hearth furnace and that is how we arrived at the total time for transfer of the potential heat in the flue gases to the brick work of about 5 seconds. It may be that this overall velocity would be somewhat less than 30 fps, and if it were in the neighborhood of 20 fps the total time available will then be 7½ seconds. This velocity is actual flowing velocity of the outgoing gases at the temperatures that obtain at various parts of the furnace.

The second question regarding thickness of checker brick, I believe was answered in my discussion of Mr. Fayles' question.

Mr. Duffy's third question regarding the strength of the brick at the elevated temperatures we expect to have, has been discussed with the brick manufacturers and they see no reason why the loads that we will have cannot be supported at these higher temperatures.

We have made some layouts showing the flue gases being brought in at the top of the checkers instead of at the bottom, and frankly the size of the duct work becomes rather cumbersome and takes up considerable room. It could be done, but the normal open hearth shop would not have this much room available for installation of the duct work and the checkers that would be required.

I want to emphasize again that the soaking pit design as shown was worked out by the Sparrows Point plant of the Bethlehem Steel Co. and from Mr. Henchen's remarks, this method of firing is apparently very satisfactory, and I wish to express my thanks to Mr. Henchen for covering the results which they obtained from these pits.

Mr. Jack Weber has certainly given us four very good points to keep in mind at all times regarding initial installations and maintenance of checker work. If these four items were constantly checked it would no doubt surprise all of us of how much more efficient our checker work would be.

Mr. Fayles asked a question regarding the maximum obtainable air temperature. No doubt there is an upper temperature limit to which checker brick can be subjected and probably every open hearth operator has passed this limit at some time and found he has a solid mass of checker brick on the top of his primary checkers. As far as the chemical constituents of the debris which is deposited on them affecting this upper temperature limit, I do not have any data on that but do not have any reason to doubt the opinion expressed here. I do know that we have had furnaces with secondary checkers in which the top of the primary checker brick reached a temperature of 2750 F and at these temperatures the brick softened and stuck together for three or four courses down. Whether this was caused purely by the brick themselves or the debris which was deposited on the brick, I do not know.

Jack E. Weber: I have one thing I would like to ask about this proposed checker work on the open hearth: One of the big questions today in the industry is apparent precipitation for dirt removal, which means the dirt is traveling through the checker work and out the stack, or they would not have to be removing it. What provision have you made for accessibility to the checkers for cleaning in your checker work, in the proposed design?

H. S. Hall: Regarding the last question—on what provision has been made for cleaning the checker brick in the proposed furnace with all vertical checkers, we propose putting bulkheads in this slope where we change from 20 to 12 ft diameter that may be opened and access gained to the top part of the primary checker and to the bottom part of the secondaries for cleaning purposes.

We have also given some thought to building these checkers in three sections. The first section to be 20 ft in diameter as shown but probably only 4 to 5 ft deep so that cleaning would be much less of a problem and in case the brick were burned there would be much less quantity of brick to be removed than in the design as shown. We believe this has considerable merit as it has been our experience with secondary checkers, as we have built them for the last five years, that the secondary checkers very seldom need replacing. In only one instance that we know of have the secondaries been replaced due to trouble with the brick and this may have been due to an excessive amount of water in the flue system. The first checkers that were installed five years ago as far as we know are still in operation in a 550-ton furnace.

We have had some suggestions from people with whom we have discussed this new design and among them was one that the slag pockets could be made larger with this design and in this manner on older furnaces the capacity of the slag pocket would be increased materially and would possibly lengthen the run of the furnace before it was necessary to shut down to clean out the slag.

We have also had another suggestion that someplace in the long flue it should be enlarged to slow down the gas velocity and thus drop out some of the carryover before it reaches the bottom of the primary checkers.

There is, of course, this factor to be considered that in this long flue with its relatively slow velocity, a certain amount of the carryover will fall to the bottom of the flue before it reaches the bottom of the primary checkers.

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Modern Methods of COMMUNICATION at Lukens Steel Company

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. . . . developments in the electronics have increased the flexibility and dependability of plant communication systems . . . .

▲ WEBSTER defines communication as "Intercourse by words, letters or messages; interchange of thoughts or opinions. Act, power or means of communicating or passing from place to place." The steel plant of today is very much dependent on reliable and rapid methods of communication, and the loss of any one results in a reduction of plant efficiency. Some of the methods used today are quite old, but are still essential to the operation and will be mentioned briefly as the methods of communication used at Lukens Steel Co. are discussed.

One of the oldest forms of communication is still used; it is the plant internal mail and United States mail systems. The written letter will always have its place in business.

Telegraph and teletype services provide a means for the rapid exchange of information between Coatesville and customers, sales offices and suppliers.

The telephone is another means of rapid two way communication. At Lukens the Bell dial system is used for calls within the plant and to the outside. Leased trunk lines are provided between Coatesville and offices in the larger cities. The Bell system is supplemented by our own 50-line dial exchange which connects the maintenance departments with vital pump stations and substations. This system has proved its worth in times of emergency when other telephone facilities were taxed to capacity or out of order. Maintenance time for this system averages approximately 8 hours per month.

A pneumatic tube system is installed to carry samples and written messages from the open hearth floor to the chemical laboratory. Previously a messenger was used and it took much longer to obtain heat analyses.

Not too many years ago the only way to communicate with a man on the open hearth floor, in the mill or scrap yard was by personal contact or by a system of lights, horns, or whistles. To convey information by these means was time consuming although lights are still used for signaling in some cases, and the whistle calls maintenance men when they are needed. Today the public address system transmits information directly to anyone within hearing range.

We have had public address systems for over twelve years in the open hearth, mills and scrap yards, maintenance shops and offices. In many locations two way communication is possible.

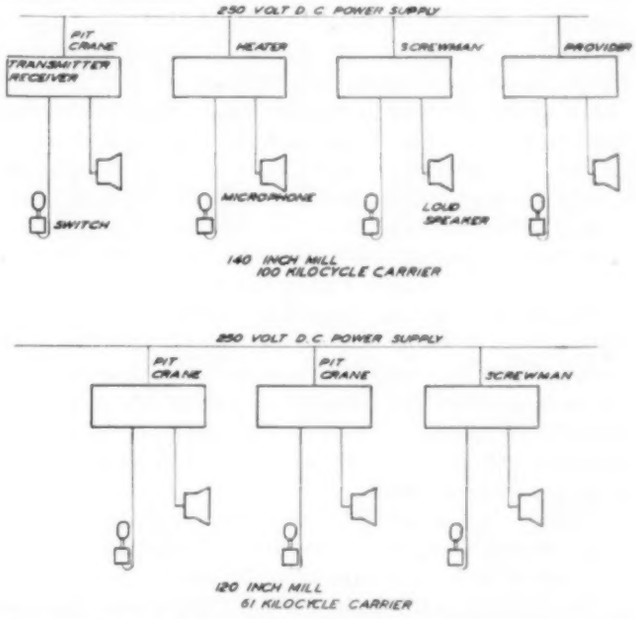


Figure 1 — The FM carrier system provides good communications between the floor and the crane.

Industrial type preamplifiers, booster amplifiers, microphones and loudspeakers are used. The preamplifiers are rated 6 watts and the booster amplifiers 40 to 70 watts. The reflex type speakers are rated 12 and 25 watts, and dynamic microphones are used exclusively. Each microphone requires a preamplifier, however, where they are in one area, as many as 12 microphones may be connected to one preamplifier.

The system is operated merely by a "push to talk" switch on the microphone. To reduce noise pickup shielded wire in conduit connects the microphone to the preamplifier. From the booster amplifier to the speakers, telephone type twisted pair wire is used; shielding is not necessary because any noise pickup is negligible compared to the magnitude of the signal.

A total of about 72 preamplifiers and power amplifiers are installed at Lukens, more than 50 per cent of them in the open hearth department. A preventive maintenance program effects a complete check of the system every four months. The main source of trouble is grounded lines, since even a high resistance ground will render the system inoperative. In spite of tight fitting covers and filters, iron scale gets into the microphones so that they must be cleaned frequently.

A total of 64 intercommunication units are in service in the offices. A preventive maintenance program results in each unit being checked every 8 months. Maintenance of all public address and intercommunication units consumes about 60 hours of a man's time per month. While it is impossible to figure savings of an installation, the convenience and amount of time saved would pay for it in a short time.

At many locations in a steel mill it is impossible to communicate with the crane operator except by hand signals or whistles because of the high noise level or enclosed crane cabs. To keep in constant contact with the pit crane operators at Lukens, an FM carrier-floor to crane communication system was installed five years ago. At the 140-in. mill the pit crane operator, heater, screwman and provider can talk to each other, and at the 120-in. mill the two pit crane operators and the screwman also have units.

Identical transreceiver units, speaker and microphone are installed at each location.

Power for the units is taken from the 250-volt, d-c system, and the current is about one ampere. The signal circuit is capacitor coupled into the same 250-volt system through the crane collectors. The units have an output of 20 to 30 watts which is sufficient to communicate over a distance of one to two miles. Our 140-in. mill installation has a carrier frequency of 100 kilocycles, while that at the 120-in. mill operates at 61 kilocycles. Therefore, there is no interference between the two installations even though the d-c systems are interconnected. Any number of installations can be made in a plant providing that each group has a different carrier frequency. Figure 2 shows a crane operator making a call.

Communication between stations is possible at anytime as long as power is available. Since a frequency modulated system effectively eliminates most noise, arcing at the collector shoes on the crane does not affect reception. A squelch circuit prevents any humming when the system is not being used, so that nothing is heard until the receiver is engaged by some one operating the "push to talk" button on the microphone.

To put a unit into service it is necessary to make only three plug connections to the power supply, the microphone and speaker. The transceivers are shock mounted on rubber.

Tubes are of the standard radio type, and components are made to plug in. Very little trouble has been experienced in our installations. A periodic three month

Figure 2 — It is very easy for the crane operator to make his calls.

check up spots a failing tube or component. The approximate maintenance time for our seven units is 2 hours per unit per month, and anyone who can service a radio can maintain them.

Costly delays have been eliminated by our floor to crane communication system since the operator can be contacted immediately and information given to him regarding which ingot to move and where to put it. He does not have to stop operating to watch hand signals or lights and then possibly misinterpret them. Possible accidents are avoided because the operator can give his full attention to his job.

By eliminating errors and delays an installation can readily pay for itself within a few days. One unit complete costs approximately $650.00.

Supervisory control, which we use between our main dispatching station and substations throughout the plant, could be considered a method of communication; however, it is a subject in itself and should be discussed in another paper.

A rapid, accurate means of communication is required between our production control department, the open hearth and chemical laboratory to schedule open hearth heats to the best advantage. With the telephone there were long delays because no one was on hand to answer or the lines were busy. The installation of a telescribing system has solved the problem.

The telescriber is an instrument, consisting of a transmitter and receiver, for electrically transmitting written messages, Figure 3. Through mechanical linkages combined with electrical circuits, identical motion of the stylus at the transmitter is transmitted to the pen at the distant receiving station.

To write, the operator must press a stylus against a

metal plate. When the stylus is lifted between words or figures a magnetic pen lifter circuit lifts the pen from the paper at the receiver. The pen on the senders receiver also writes so that the message being sent can be seen. At the end of a message the stylus is moved to a ratchet switch, which when pressed, de-energizes the receiver writing circuit and allows the pen to drop into an ink well for re-inking. At the same time the paper is advanced.

Our system is arranged so that when one station is writing, the message is received simultaneously at all others. A lockout provision prevents anyone else from breaking in until the message is completed. A buzzer signal is provided between stations to attract attention should an immediate reply be required. A-c at 115 volts must be provided at each location and four wires interconnect the stations.

From the open hearth pit office, the times for tapping, stripping and loading a heat are transmitted to production control who in turn advises the ingot conditioning yard when the ingots will arrive. Heat analysis is transmitted from the chemical laboratory to production control to be checked against the required analysis.

With all the information received on the telescribing system a continuous flow of ingots to the rolling mills can be scheduled. The system transmits information when no one is in attendance on the receiving end, thereby eliminating the delays which were incurred when telephone only was used. This is especially beneficial at night when the working force is reduced. The information received is used as the record by tearing the sheet off the roll of paper; therefore, there is no chance of error because of a misunderstanding.

Approximately 18 months ago we installed a two way FM radio system to provide communication between the dispatcher and company trucks and between the plant protection department and police and call cars. The original installation consisted of a 60-watt base transmitter and five 30-watt mobile units installed in two pick up trucks, a tractor trailer, the police car and the call car. Later, units were installed in the fire department jeep and in three narrow gage diesel locomotives.

The base transmitter and antenna are located on a hill in the center of the plant, Figure 4. The transmitter is remotely controlled from the truck dispatch office and the plant protection department, the latter location being the control and logging point. The maximum range of satisfactory communication is about 10 miles on our frequency of 152.99 megacycles. Reception when a truck is inside a steel building is as good as when it is outside.

Figure 3 — The telescriber allows immediate communication to unattended stations.

Figure 4 — Transmitter is located on a hill in the center of the plant.

The base station operates on 115 volts a-c. The mobile units in the trucks and cars operate from the six-volt vehicle battery. To keep batteries charged heavy duty generators have been installed. The same type mobile units are installed in the locomotives, thereby making all units interchangeable. To obtain six volts in the locomotives a separate battery is installed with a six-volt generator driven directly by the diesel engine. Since severe shocks are encountered with rail equipment, the two-way radio equipment is shock mounted.

We installed the radio equipment with our own personnel, and operation of the units requires only simple preliminary instruction, Figure 5 shows an installation in a pickup truck. Once the mobile unit is turned on, incoming calls are automatically received. To transmit it is necessary only to operate the "push to talk" button on the microphone. When no signal is being received an efficient squelch circuit eliminates any noise. Reception is practically noise free since frequency modulation is used.

Operation of the base station transmitter from one of the remote control points, Figure 6, is the same as that of the mobile stations; a push to talk button on the desk microphone turns the transmitter on and off. In addition, the two dispatch points may communicate with each other by means of a built in intercommunication feature, which when used does not put the transmitter on the air. Only one twisted pair line is required between the dispatching points and the transmitter.

We do our own maintenance and frequency checking work, having a licensed man in the company. After a few initial troubles with the equipment, break downs are now infrequent, tube and vibrator failures being the biggest sources of trouble. A schedule has been set up to check each unit every six months. At the same time the transmitter frequency, frequency deviation, and

Figure 5 — Radio equipment is installed on a number of the mobile units.

power input are checked in accordance with the Federal Communications commission regulations. One mobile unit is kept as a spare so that a defective unit can be put on the repair bench, and service still maintained.

For the base transmitter and six mobile units our maintenance and checking time has averaged 2 hours per month per unit. Replacement tubes, and parts have cost approximately $2.00 per month per unit.

Initial equipment cost was approximately $1200 for the base transmitter and $600 each for mobile units. A license must be secured from the Federal Communications Commission for which there is no charge, and operators must have a third class license.

Prior to the installation of radio, truck or car location was known only if the driver called headquarters on the telephone. Trucks returned empty when they could have picked up a load enroute, which meant that expensive equipment was not utilized to the fullest extent. Now by a call from the dispatcher — "KGA 336 to car 2" — the driver can be told where his next haul is. The drivers also report to the dispatcher after a load has been delivered. With radio the same number of trucks can now handle a greatly increased load.

The police car is now in constant contact with headquarters. Any unusual conditions can be immediately reported or assistance requested if necessary. With radio in the fire department jeep additional men can be called to the scene of a fire if required. The same number of men in the plant protection department can work much more efficiently since the man out in the car can always be contacted immediately if needed.

Radio has been invaluable in our hot charging program. The hotter the ingots are when received, the less time required in the furnace. This increased efficiency of operation was made possible by equipping the yard masters truck with radio so that he can be contacted immediately when ingots are ready to go to the mill. The operation has been further improved by the installation of radio in the narrow gage locomotives, Figure 7. The dispatcher and yard master know at all times the location of the locomotives and can order moves when required. In the past it was necessary for the yardmaster to run all over the plant to locate a locomotive. Derailments and wrecks are now immediately reported to decrease out of service time.

While tangible savings are difficult to estimate it is probably safe to say that the radio installation has paid for itself in 18 months. On the basis of its performance it is anticipated that many more mobile units will be installed in the future.

Industrial television will soon be installed at Lukens on a 360-ft long continuous plate annealing furnace and quench press line. The operator can not see the operation of a swing table at the exit end of the furnace. This table swings through 90 degrees to turn the plate for handling by the crane, and the operator must be sure that the area is clear. A television camera will be installed at this location to "see" for the operator. At the control pulpit a standard 17-in. television receiver with an associated control unit will be installed for viewing. Limit switches controlling indicator or warning lamps, which are applied in many places, would not give the operator the overall picture that television presents.

Should a second camera be required, the television receiver could be switched from one to the other simply by turning the channel selector switch. A camera can be 500 feet away from the receiver, and a good picture

Figure 6 — Push-to-talk button on the desk microphone turns the transmitter off and on.

Figure 7 — Radios are also installed on the narrow gage locomotive.

will still be obtained. A 12-conductor cable and two coaxial cables connect the camera and control unit. The source of power is 115 volts a-c; power consumption being about 400 watts including the receiver.

One camera, associated control and a receiver costs approximately $1200, and cable is 25 cents per foot. The Vidicon tube has a life in excess of 3200 hours and costs $345. The other ten tubes in the camera and control unit are radio type.

With television a second man will not be required at the end of the furnace to advise the operator of conditions. Labor is a big item today so any reduction will quickly pay for the television equipment. Maintenance costs should not be high since any good television repairman can maintain the equipment.

After our first experience with television there is no doubt that other applications will be found where costs can be reduced by its installation.

In conclusion it can be said that each of the forementioned methods of communication fulfill a need and are necessary for efficient plant operation according to today's standards.

DISCUSSION

PRESENTED BY

NORMAN ROLFE, Electrical Engineer, E. I. du Pont De Nemours and Co., Inc., Wilmington, Del.

C. N. CODDING, Plant Engineer, United States Pipe and Foundry Co., Burlington, N. J.

A. LUDWIG, General Boiler Foreman, Bethlehem Steel Co., Sparrows Point, Md.

E. L. ANDERSON, Superintendent, Electrical Dept., Bethlehem Steel Co., Johnstown, Pa.

JAMES A. B. PINNEY, Electrical Design Engineer, Alan Wood Steel Co., Conshohocken, Pa.

K. G. SNYDER, Engineer, Electrical Dept., Bethlehem Steel Co., Steelton, Pa.

F. C. SCHOEN, Chief Engineer, Alan Wood Steel Co., Conshohocken, Pa.

GILBERT P. CARDWELL, Electrical Design Engineer, Lukens Steel Co., Coatesville, Pa.

CLIFFORD BURDICK, Technical Assistant, Lukens Steel Co., Coatesville, Pa.

Norman Rolfe: I am wondering if you are at liberty to state which manufacturer's equipment is used, the models, and if any of this industrial television equipment was pilot run or if you had seen it in operation at other people's places?

C. N. Codding: My question is what trouble has been experienced in the telautograph system and pneumatic tube system, if any, which was not touched on in the paper.

A. Ludwig: I would like to ask the speaker if he has had any experience with portable sets, where perhaps an individual walking around in the plant might use part of the radio system?

E. L. Anderson: I have one question concerning the use of tone control used to provide selective conversation between the various groups on a single frequency. I would like to know if he has considered the use of such control on their 153 megacycle FM frequency.

We installed in the Johnstown plant a few years ago a system operating on a frequency of 153.41 megacycles. The complete system consists of one main console, three auxiliary consoles, control units, seventeen mobile units and a 60-watt main transmitter of the frequency modulation type. Due to the type of service required of this system, it was deemed necessary to provide selective conversation between the main station and the four selected groups. This was accomplished with the use of tone controls.

During normal operations, all of the receivers are locked out. A mobile unit calling the main station identifies the group that it has been assigned to. The operator at the main console unit sends out a tone signal which unlocks the receivers in that particular group of mobile units. Conversation is then carried on in a normal fashion. During the time that this group is talking, the receivers on the other three groups remain locked out, thus isolated communication with each group is accomplished, providing in effect five independent groups on a single frequency.

James A. B. Pinney: I would like to ask Mr. Cardwell if he has experienced any difficulty with the operating personnel in first using this radio equipment. Also, I would like him, if he could, to give us an estimate of the outage time per set, per month, or per week, for the equipment used, particularly on the locomotives.

K. G. Snyder: I would like to ask Mr. Cardwell if they have experienced any trouble with the re-tuning of these transreceiver units in the field, and if so, what methods are used?

F. C. Schoen: At Alan Wood we have made a number of communication system installations, with one very interesting installation. We recently installed a 60-cycle turbo-generator at our plant, located on one side of the river. We tie in with the public utility on the opposite side of the river.

This has presented some problems, since at certain stages of operation our tie-lines across the river must be used to supply power to the Swedeland Division and if we have a disconnection with the public utility, we have to synchronize the turbo-generator with the public utility at a point three-quarters of a mile away from the power house. We have been using an FM system carrier type for synchronization, in which the operator in the blooming mill motor room has been using the FM unit and having the operator in the power house pick up or drop the speed of the turbo-generator, so that the blooming mill operator can synchronize and close his breakers.

We thought this was an application of this type equipment which might be of interest to you.

Gilbert P. Cardwell: Mr. Rolfe asked a question as to what type television we were planning on using. We will use a closed circuit industrial type television system of which there are a number on the market. We have not observed a pilot run or made any pilot run before contemplating this particular installation.

Mr. Codding inquired about troubles in the telautograph system and pneumatic tube system. On the telautograph system, the only thing I have heard of is that occasionally they run out of ink, and a few minor adjustments are at times necessary. I might

mention that this system is in our plant on a rental basis and If we do run into serious trouble we can call on the telautograph people. Up to now it has not been necessary to call on them.

In the pneumatic tube system occasionally something becomes clogged in the system, but I do not know how often it happens.

Clifford Burdick: The telautograph system averages about one service call every two months, and the pneumatic tube system is about the same. In general, the repairs required are very minor.

Gilbert P. Cardwell: On the question regarding portable radio equipment, that is, hand-carried equipment or walkie-talkies, we have not had any experience with them. As a matter of fact, one of the suppliers advised us against thinking too much of using them. He said that we would have better success just sticking to the units in the vehicles. Their range is limited, and you frequently have to have the batteries charged.

We have a radio in the police car, and the man is never far away from it when out on patrol. If he were patrolling on foot I could see where the walkie-talkie might come in very handy.

I want to thank Mr. Anderson for his comments on the tone control for group selection. Thus far we have not put that system into use at Lukens. It is very desirable, particularly if you could only obtain one frequency from the FCC, and that is the case today, since there is such a demand for the channels available. With the system Mr. Anderson mentioned, one frequency is used, but by means of tone control any particular group of radios can be contacted. I can see where it would be very useful on some installations. We may find use for the system in the future.

To answer Mr. Pinney's question on operating personnel problems. After a few initial instructions on the use of the radio and a day or so use of it, we have not had any particular problems with the personnel. At first they had to be reminded several times to watch their language while on the air, as you can all very readily understand. And there are times when they push the push-to-talk button on the microphone and forget to let it go when they listen, and wonder why they do not hear anything, or, at times, the reverse is the case, they let go of the button before finishing what they are saying.

As to the question on outage time per unit, I can not say too much about that. We have not had radio installed too long on the diesel locomotives. Thus far, with the experience we have had, in the locomotives we have had practically no trouble, but, as I say, the time has been very short — only a matter of a month or so.

As to estimating outage time per set, I would say that now that we have our maintenance procedure set up, it does not run over an hour at the most. If repairs can not be made in about an hour, we usually substitute our spare transmitter and receiver unit, and take the other back for repairs.

Clifford Burdick: On the trolley-phone we had considerable trouble from six to twelve months after we installed the first set of equipment. This was due to the fact that when we turned the sets, we tuned one against the other and we gradually drifted off the frequency range for which they were designed. At that time we purchased a signal generator designed to cover the frequency range required by the equipment, and since then we have had very little trouble of this type. The sets are always tuned or repaired in the shop. Very little field maintenance work is attempted. The unit is pulled out, brought to the shop, returned or repaired, and taken out again. We do not carry any spare sets, however, as you saw on the illustrations, we have a number of sets on each system and we can keep the essential portion of the system working by trading sets around while one is in for repairs.

Gilbert P. Cardwell: As I mentioned, we keep tabs on the mobile radio frequency. We find that the frequency drifts at times and we have to bring them back on frequency again. Reception can be affected a little, as the crystals drift, but that trouble has not been serious.

AISE SPRING CONFERENCE

APRIL 25, 26, 27, 1955

HOTEL STATLER DETROIT, MICH.

Extensions to Electrical Generating and Distribution Systems at Bethlehem's Sparrows Point Plant

By H. D. RUGER
Assistant Electrical Engineer
Bethlehem Steel Co.
Sparrows Point, Md.

. . . . increasing operational requirements constantly necessitate expansion in power generating capacity . . . .

▲ A paper presented before the AISE annual spring conference in 1949 gave the facts on our Pennwood powerhouse with its two original 33-mw generators and the 34.5 kv transmission and distribution system. See "Power Supply and Electrical Features of Sparrows Point 68-in. Hot Strip Mill," by F. O. Schnure, 1950 Proceedings AISE pp 220-224. Incidentally, these two Pennwood turbo-generators, each rated 30,000/33,000 kw, with a maximum rating of 39,780 kva, have each been averaging 40,000 kw.

The monthly consumption of electric power at Sparrows Point is between 110 and 112,000,000 kwhr. Of this total, approximately 5 per cent is purchased as 25-cycle and 15 per cent as 60-cycle power; 30 per cent is generated as 25-cycle and 50 per cent as 60-cycle power. During normal operation the hourly loads will average 175 mw. The maximum instantaneous peak is 228 mw.

Along with the authorization of a new No. 9 blast furnace, a third boiler and topping or superposed turbo-generator was approved for Pennwood in 1952. As there was a need for low pressure, 250-psi steam as well as more generating capacity on account of the increased plant load, the superposed turbine exhausting at 275 psi pressure, was found to be the most practical. The boiler for this unit is similar to the original two boilers and is capable of delivering 400,000 lb of 1030-1100 psi, 900 F steam per hour. The three boilers are connected to a common header through valves.

Electrically, the new No. 3 Pennwood generator has the following ratings: 20,000/25,000 kw, 85 per cent power factor, 13.8 kv, 60-cycle, 0.5/30 psi hydrogen pressure. This unit is directly connected to a 25,000/33,000-kva, 13.8/34.5-kv, three-phase, OIFA transformer. The generator is also directly connected to a 3000-kva 13.8/2.4-kv, OISC, three-phase unit auxiliary transformer which serves all auxiliaries, either 2400 volts or through transformers, at 480 volts, that are associated with this turbo-generator and boiler. Figure 1 shows, in simplified form, a one-line diagram of the Pennwood power house electrical system.

In case trouble develops on any one of these generators, sufficiently serious to operate the lockout device, automatic transfer of the turbine and boiler auxiliaries is made from the turbo unit auxiliary 2300-volt transformer to the station auxiliary 2300-volt transformer.

The most modern type of protection has been installed on this No. 3 generator. For instance, the type HDD harmonic restraint percentage differential protection has replaced the type IJD for protecting the generator and its main and unit auxiliary transformers. Directional or anti-motoring protection has been added, due to the fact that a topping turbine may only run approximately 40 seconds before possible damage is done to the blading after the throttle has tripped. As back-up protection, overload relays with voltage restraint type IJCV have replaced the standard type

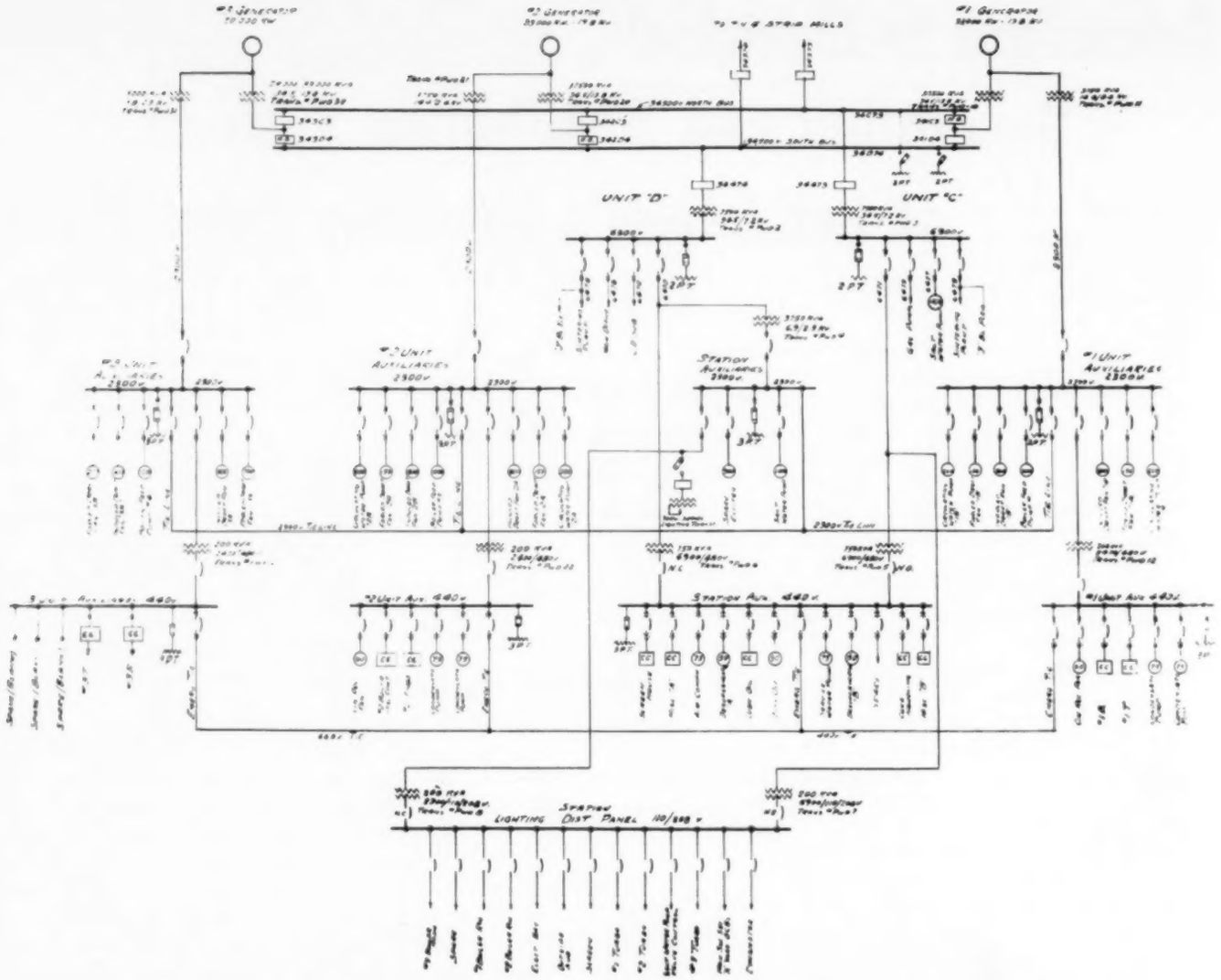


Figure 1 — One line diagram shows electrical distribution from Pennwood power station.

IAC overload relays. No. 3 turbo-generator was put on the line December 23, 1953.

From Figure 1 it can be seen that No. 3 generator and its step-up transformer like No. 1 and 2, may be connected to either 34.5-kv bus. It is planned that it will normally be connected to the 34C73 or north bus at Pennwood because of the fact that the new blooming mill sub, referred to later, is normally connected to the circuit feeding from this bus. This will tend to balance the loads on the local utility company cables. The 34.5-kv cable 34373, that will transmit the Pennwood generation of units 2 and 3, is bare 750,000-cm copper cable with a spacing of approximately 8 ft between conductors. This cable should carry safely 900 amperes or approximately 600 amp from No. 2 generator transformer and 300 amp from No. 3 generator transformer.

The two original Pennwood 34.5 to 6.9-kv, 7500-kva transformers were installed for station auxiliary service and future steel side 60-cycle load. Each of these transformers fed a 6.9-kv bus with four 1200-amperes, 500,000-kva IC feeder breakers initially installed, with only one of these breakers on each unit serving the station auxiliaries. Since 1949, all six spare breakers have been put in service and the load increased to a point where these auxiliary transformers might not serve as an emergency station auxiliary source. See Figure 2, which is a simplified schematic one line diagram of our high voltage plant inter-connections. The following additional equipment has been connected to the two subject 7500-kva transformers since 1949:

1. Main office building with its two 450-kva transformer banks.
2. Coke oven sub-station with its 1000-kw mercury arc rectifier.
3. Coke oven area including the following unit subs: two 500-kva, four 750-kva, three 1000-kva, one 1500-kva, and one 2500-kva.
4. Gas pumping station consisting of two 1000-hp and two 2000-hp synchronous motors, two 750-kva and two 1000-kva unit subs.
5. Electrical repair shop with its one 750-kva unit sub.
6. Hospital with its 150-kva unit sub.
7. Sintering plant with its 1000-kw mercury arc rectifier, two 1000 hp synchronous motors and three 750-kva unit subs.
8. No. 9 blast furnace with its 1000-kva unit sub.
9. Pennwood salt water pump of 1500-hp.

This total installed capacity of 31,250-kva has been

a gradual increase and of course is not fully loaded. Since 22,500-kva of the above installed capacity was being fed by two open 250,000-cm, 6900-volt feeders, one mile long, low voltage conditions became apparent at these loads. This all added up to the fact that something had to be done. The following is an explanation of the solution to this problem.

In 1952 a partial speed-up of three blooming and slabbing mills was approved. This necessitated new 60-cycle service in the blooming mill area which prior to this time had been served with 25-cycle from the original loop system. An outdoor sub-station was designed for two 20,000-kva transformers to step the plant 34.5-kv transmission voltage down to 6900 volts. At present, only one such transformer is installed. Although this station is now served by tapping the two utility company's 34.5-kv lines, it was engineered to fit into the future west section of the 34.5-kv loop system, at which time the outer or 34773 loop will probably be taken through this station with "in and out" breakers.

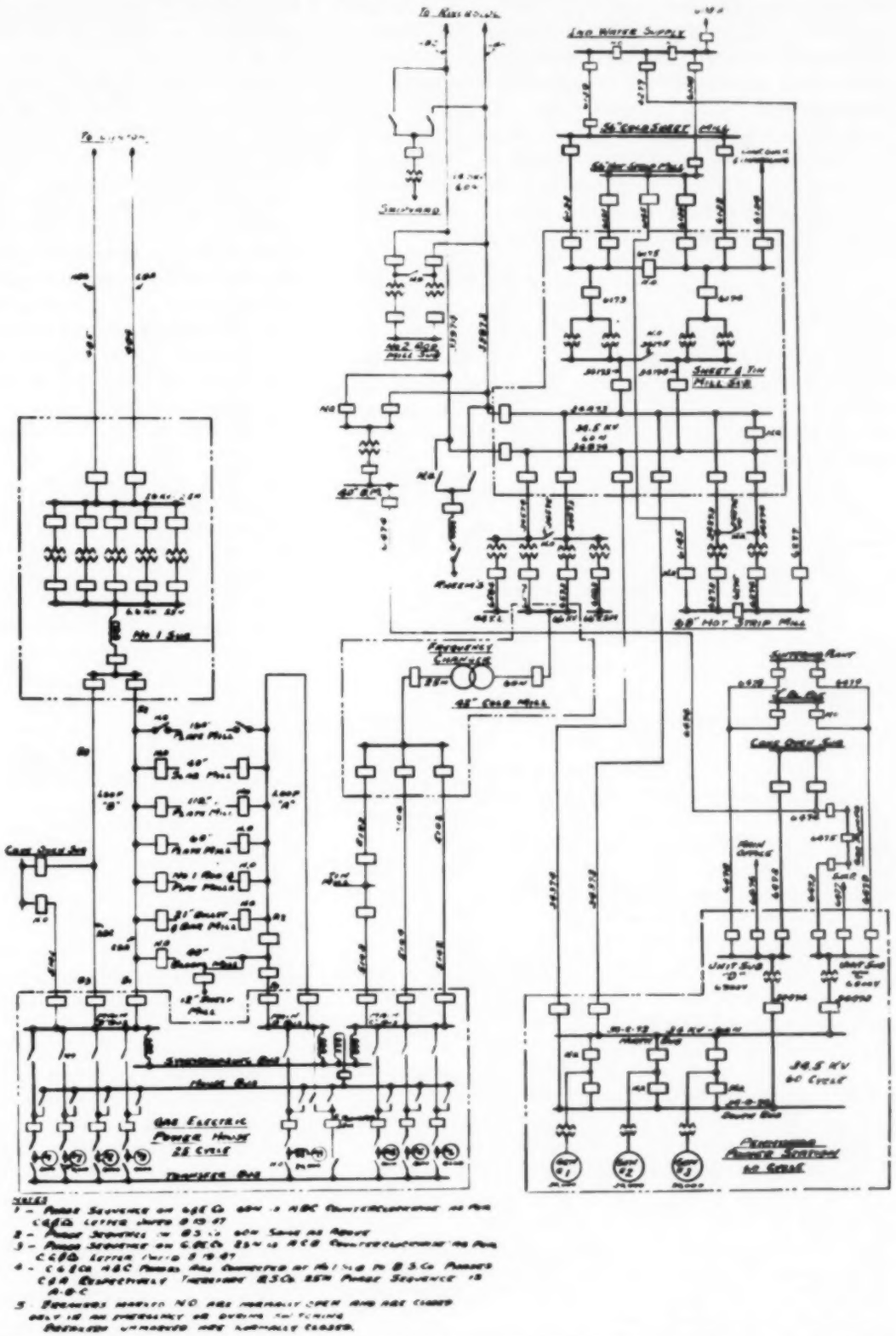


Figure 2 — Simplified schematic one line diagram shows high voltage plant interconnections.

With the blooming mill outdoor sub-station completed, an 800-amp, 6.9-kv line was extended between the coke oven sub, gas pumps sub and the blooming mill. This one-mile circuit consists of three open 795,000-cm ACSR cables and was installed on a vacant position on the 25-cycle loop towers. This circuit relieved the low voltage conditions in the coke oven area as well as restored the Pennwood station auxiliary transformers for their intended duty.

The above mentioned tie presented a phasing problem which was originally anticipated. At the various mills and sub-stations at Sparrows Point, three-phase transformers are used to step down the 34.5-kv to 6.9 kv. These transformers are all of the OISC or OIFA variety in capacities of 7500, 10,000 and 1500/20,000 kva. The high-voltage sides of these transformers are delta connected, working off the solidly grounded neutral systems of the local utility and the Pennwood power house of Bethlehem Steel Co. The low voltage sides are all connected wye with the neutral grounded through resistor-reactor combinations or resistors alone to limit the ground fault current to approximately 2000 amperes.

As is well known, when power is transformed through a delta-wye transformer, a phase shift of 30 degrees is realized between the high voltage and low voltage sides. On account of a local condition, the two 7500-kva station auxiliary transformers at Pennwood were initially connected "A" phase to H3, "B" phase to H2 and "C" phase to H1. This was just the reverse of the connections on all previous delta-wye transformers at Sparrows Point.

This of course, meant that with the 34.5-kv common throughout the plant, the 6.9-kv from the two Pennwood station auxiliary transformers was phase-shifted 30 degrees in one direction with respect to the 34.5-kv while the 6.9-kv from other plant transformers was phase-shifted 30 degrees in the opposite direction, or a total of 60 degrees phase shift existed between the 6.9-kv sources. This offered no problem as long as it was not necessary to parallel these sources. But this time had finally come and reality had to be faced.

To correct this phase shift, the following procedure was decided upon. Interchange the A and C phases on the high-voltage sides of both Pennwood 7500-kva transformers as well as interchange A and C phases on the low-voltage sides. This would shift the Pennwood 6.9-kv the required 60 degree phase angle for paralleling purposes, as well as maintain the original phase rotation so that all equipment already connected would continue to run in the proper direction, and the original transmission line conductors would continue with the same phase configuration. It was very important to have the phase rotation remain the same as many three-phase motors ranging in size from 1 to 2000 hp were already connected to this system either directly on 6900 volts or through step-down transformers.

Since it is almost impossible to secure an outage of the coke ovens, gas pumps, etc., a scheme had to be developed, to make the phase shift on the subject transformers with a minimum of outage time. A program was planned and completed in 8 hr. Everything went smoothly.

During the study prior to the aforementioned change, it was ascertained that the proposed Pennwood phase shift would throw the station auxiliary 2300-volt bus out of phase with the turbo-generator unit auxiliary 2300-volt buses. This 2300-volt station auxiliary bus is fed from a 3750-kva delta/delta transformer whose primary is connected to one of the two 7500-kva transformers that were to be phase shifted. This 2300-volt station auxiliary bus was originally in phase with the unit auxiliary buses. Although these two 2300-volt source breakers are interlocked electrically so that both can not be closed at one time, it was felt that in case of trouble, an attempt might be made to parallel these two sources and the electrical interlock fail. The next problem, then, was to secure a 60 degree phase shift with a delta/delta transformer. For the answer to this the help of the concern who made the initial installation was requested. The following is their solution:

1. Disconnect the low voltage delta inside the transformer.
2. Inter-change the start and finish leads of each phase winding.
3. Re-connect the delta. This will give a 180 degree phase shift.
4. Then rotate a phase, thus, 180 minus 120 gives 60 degrees, the desired phase shift.

This solution has been verified with the manufacturer and they are preparing to ship a new name plate as well as the necessary jumpers, connectors, etc. to make the required internal wiring changes in the field.

The Sparrows Point power system is unique in having five different sources of electric power, namely:

1. The local utility service on 25 cycles, consisting of two 26.4-kv circuits with an installed transformer capacity of 37.5 mva.
2. Bethlehem Steel Co. generation on 25 cycles consisting of 8 generators with a capacity of 51 mw.
3. The local utility service on 60 cycles consisting of of two 34.5-kv circuits with a combined capacity of 80 mw.
4. Bethlehem Steel Co. generation on 60 cycles consisting of three generators with a capacity of 109 mw.
5. Bethlehem Steel Co. frequency changer connected between the 25 and 60-cycle systems capable of transferring 22 mva from either system to the other.

Since 1949 the following generating and distribution equipment has been installed at Sparrows Point: 25,000 kva in generating capacity, 82,000 kva in 34.5-kv to 6900-volt step-down transformers, 16,000 kva in 6900 to 2400-volt transformers, 34,000 kva in 6900 to 480-volt transformers, 5500 kw of mercury arc rectifiers for converting 6900 volts alternating-current to 250 volts direct-current, 1½ miles of three-phase 34.5-kv transmission lines, and approximately 10 miles of three-phase 6900-volt transmission lines.

The Sparrows Point distribution system has the flexibility of a double-loop system on 25 cycles as well as plans for a double-loop system on 60 cycles sometime in the future. Nevertheless, once in a while, Sparrows Point, with its multiplicity of power sources and flexible distribution systems, has an outage that causes cobbles in mills here and there. As a consequence, we are still looking for an anticipator that will warn us of an on-coming outage.

DISCUSSION

PRESENTED BY

S. H. MUMMA, Superintendent Electrical Dept., Bethlehem Steel Co., Steelton, Pa.

H. D. RUGER, Assistant Electrical Engineer, Bethlehem Steel Co., Sparrows Point, Md.

L. V. BLACK, Superintendent Electrical Dept., Bethlehem Steel Co., Bethlehem, Pa.

K. L. JOHANNSEN, Division Superintendent of Maintenance and Utilities, United States Steel Corp., Fairless Hills, Pa.

S. H. Mumma: With all the different sources of power of such high capacities, do you have trouble with interchange of power between the different systems? You probably have quite a system of relays and protective equipment, but in general, how is it controlled?

H. D. Ruger: We do have quite an interchange of power between the various systems, namely, between the utility company and Bethlehem Steel Co., and also between our 25 and 60-sycle systems, but I would not say that we had too much trouble on this account. Normally, the governors on all our turbo-generators are wide open, therefore, we carry the base load while the utility carries the peaks. At times of minimum plant load, such as week ends, the generator governors are cut back to reduce back-feed to the utility to an amount which is equivalent to the excess power that can be generated from steam produced by blast furnace gas. Our frequency changer is a synchronous-synchronous unit with stator shift on the one unit. This stator shift may be controlled from any one of three positions, namely from the machine location, from the 60-cycle load dispatcher's location or from the 25-cycle load dispatcher's location. Therefore, either load dispatcher may transfer blocks of power from one system to the other by shifting the stator of the frequency changer.

During fault conditions, large blocks of power may flow from the various systems to the faulted system, but modern protective relaying usually separates the systems and clears the faulted circuit. Also, a high load alarm warns the load dispatchers of a high interchange of 60-cycle power between the utility and the steel company as well as giving a red signal to the 56 and 68-in. hot strip mills to refrain from discharging slabs onto tables for rolling while the red signal is on. As the combined peaks of these two mills may reach 50 megawatts, a considerable drop of interchange may be realized.

L. V. Black: It may be interesting to note that one year ago I returned from the Sparrows Point plant to find that the Bethlehem plant had a complete power shutdown due to a bad sleet storm which covered all the Bethlehem area as well as the entire area served by the local power company system. The power company lost all their main power and tie lines, including a number of steel towers.

Approximately half of the power used in the Bethlehem plant is supplied by the power company and as a result of Bethlehem trying to maintain contact with the power company during this emergency, a complete plant shutdown resulted.

Bethlehem immediately took steps to analyze the entire power problem against a possible future repetition of such conditions and decided on the following. At a predetermined value of drop in the system voltage, the electric arc furnaces will automatically be dropped. The loss of this big power load may be enough to stabilize the power system, however, if the system continues to fall off, the interconnecting ties with the power company will be opened at predetermined values of low frequency by means of under-frequency and power directional relays. By this scheme the plant power generation will supply all vital loads such as water pumps, etc.

This scheme and equipment has been installed and tried out manually. We feel confident it will work to our satisfaction when needed.

I would like to ask Mr. Ruger if the relaying schemes at his plant provide for automatically dropping loads or isolating parts of the power system under adverse conditions, either on the 60-cycle or 25-cycle systems.

H. D. Ruger: The relaying schemes at Sparrows Point definitely do provide for automatically dropping the load and isolating parts of the system under adverse conditions.

We have power directional relaying schemes on all the utility company ties which open their respective tie breakers on abnormal power flow toward the utility. On 60 cycles, a high load on the utility tie operates a high load alarm, mentioned previously, causing slow rolling at our hot strip mills.

On 25 cycles, our most important loads are fed from the house-bus, a preferred bus that has generation on it as well as a tie breaker to the synchronizing bus and thus the rest of the 25-cycle system. This house-bus tie breaker has directional and undervoltage protection which separates the house-bus from the system in case of low house-bus voltage or abnormal power flow from the house-bus to the system.

The frequency changer has inverse time overload protection that will open its breakers in case of an abnormal power flow between the 60 and 25-cycle systems.

K. L. Johannsen: Do you have supervisory control on any of the breakers? I was interested to note how he corrected the angular phase displacement problem. I assure you that happens not only in old plants, but when you have a dozen contractors connecting in on a new system.

H. D. Ruger: We do have supervisory control of all 34.5-kv breakers and some of the more important 6.9-kv breakers. The 34.5-kv breaker supervisory control is under the jurisdiction of the 60 cycle load dispatcher. Along with the supervisory control of these breakers, there are indicating instruments working from torque balance telemeters, etc. to indicate the loading, both power and reactive as well as voltage at the various points of the system. Besides the synchronism check relays installed at the various locations to assure the systems being in step before the breakers will close, the load dispatcher also has a synchroscope on his supervisory panel which indicates the phase relationship of the systems he is tying together. If systems were out of synchronism, the operator can shift the stator of the frequency changer to synchronize the systems and allow the breakers to close.

LUBRICATION PRACTICES at Alan Wood Steel Company

By R. G. LEISTER
Lubrication Engineer
Alan Wood Steel Co.
Conshohocken, Pa.

. . . . ingenious applications of sound lubrication design principles have resulted in better and more economical operation . . . .

▲LUBRICATION of the many operating units that go to make up a steel plant has become more and more complex through the years, due primarily to the greatly increased speeds employed and the desire of management to hold production delays to a minimum. This paper is concerned primarily with the modern control of existing lubricating devices and methods of application. It will also be noted that considerable need is manifested in regard to modification to the so-called tailor made equipment in order to better meet the existing conditions encountered in the various types of mill operation.

One of the prime requisites of any lubrication control program is that of providing good housekeeping in the application of the lubricant proper. Where proper control is exercised in the field of lubricant application, it is always found that effective savings, better gear life and better bearing life are also obtained in addition to the heretofore mentioned good housekeeping.

Inasmuch as steel mill machinery is of the heavy duty type, which entails considerable capital expenditure, it is mandatory in the process of manufacturing steel to hold the replacement and repair of such units to an absolute minimum. Lubrication in its many ramifications plays a most important part in making this possible.

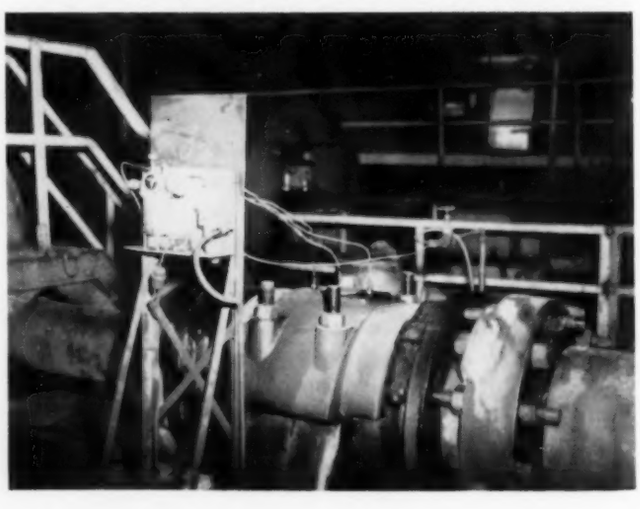
OIL MIST LUBRICATION

One of the major problems encountered in the lubrication of the roughing mill train drive of a hot strip mill was the attendant loss of lubricant from the line shaft and lead shaft bearings as a result of creepage from the bearing proper along the shafting and then to the floor. This presented a very unsightly condition in addition to a major loss of lubricant from the circulating system.

A study was made of the problems noted which revealed a loss of approximately 200 gallons of lubricating oil per week (at a cost of approximately $146.00) from the system in question. It was first attempted to meet this condition by designing and installing oil flingers on the shafting within the confines of the bearing housing. While this showed marked improvement it was still found to be inadequate. The next step was to design and install several types of sealing devices. Here again some improvement was noted, but it was found that the loss of oil and the poor housekeeping conditions still prevailed to such an extent that it was deemed advisable to continue the study of the problem with the hope of finding a more satisfactory control medium.

Further study revealed that the amount of lubricating oil required for general rolling conditions imposed a difficult problem of oil retention during the period when the mill was down for a short period of time. It was found that as soon as the shaft rotation was stopped, the pumping action within the bearing ceased and the static shaft offered a measured restriction to the flow of oil from the bearing inlet and to the bearing drain. This caused a welling action of the sur-

Figure 1 — Oil mist lubricator was successfully applied on the roughing mill train drive of the hot strip mill.



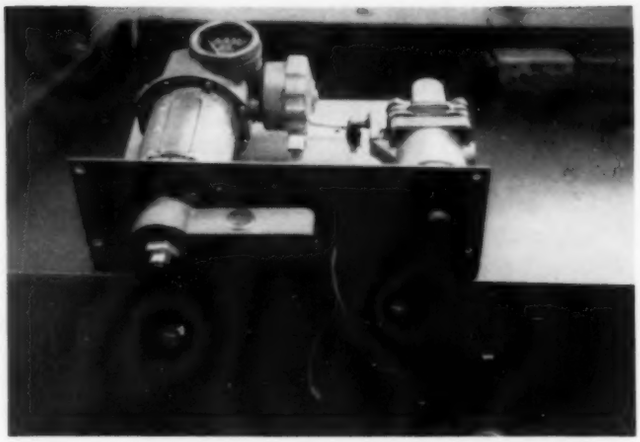


Figure 2 — In operation, the lubricator baffle adjusting screw was set to eliminate the mist forming action and passes the lubricant in the liquid phase from the reservoir to a common type header.

plus oil within the bearing which permitted the oil to be forced past the seal and on to the mill floor.

Although no known application usage of oil mist lubricators was reported with respect to steel mill applications of this type, it was decided to experiment with same in the hope of providing effective control with a minimum of lubricant consumption. Some of the major points of vantage seemingly offered by oil mist lubrication are that it provides continuous lubrication with automatic control in a fairly simple manner. It was also felt that the possibility might exist whereby the oil mist would provide a wall of resistance to the infiltration of airborne contaminants within the bearing housing. Field experience shows that this latter mentioned theory did not prove of practical value. It was found to be mandatory to apply a small quantity of lubricant in the liquid phase rather than in the form of a mist as proposed due to the nature of the heavy bearing loads encountered.

In order to provide the desired globule of lubricating oil of measured size, the lubricator baffle adjusting screw was set to eliminate the mist forming action, but rather to pass the lubricant in liquid phase from the reservoir to a common pipe header. The header, in turn, is joined with tubing to condensing fittings which are connected to the bearing cap.

Another problem encountered with this application was the reported maximum oil viscosity limitation of 1000 seconds SUS at 100 F, for a lubricating device of this type. Inasmuch as we were utilizing an extreme pressure lubricant of approximately 1800 seconds SUS viscosity at 100 F for other lubrication applications at this mill location, it was decided to attempt to further modify the lubricator to use the heavier bodied lubricant. To accomplish this desired change it was necessary to select and install larger sized condensing fittings.

Shock loading conditions resulting from the product passing through the mill rolling stands also developed a problem in the nature of breakage of the lead wires from the power source to the heating element located in the reservoir of the lubricator device. To satisfactorily meet this situation it was necessary to replace the existing wires with a wire of a larger size. The original mounting location for the lubricator was on the bearing cap, but here again due to adverse shock loading conditions it was deemed advisable to relocate it on a suitable bracket independent of the bearing pedestal and securely attached to the mill floor. The auxiliary air supply line complete with filter control valve etc., are also mounted on the same bracket as the lubricator proper.

The supply line from the lubricator to the bearing is of flexible type construction to prevent any tendency to transfer the shock loads from the bearing to the lubricator.

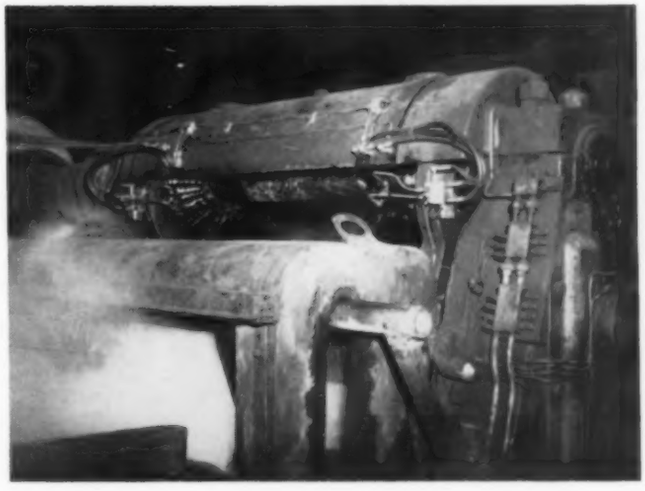
This experiment has continued since January 1953 and it might be concluded that this method of lubricant application has proven to be of sufficient benefit to warrant further similar expenditures in other locations. Considerable improvement has resulted in better housekeeping as anticipated in conjunction with the desirable savings in lubricant. Our records today have shown a modest consumption, as compared to previous practice, of approximately four ounces per hour per station. The total number of stations currently operating is thirteen which makes a total of fifty two ounces per hour for the entire roughing train.

AUTOMATIC APPLICATION OF HEAVY DUTY LUBRICANT GEAR SPRAY

The lubrication of the open bevel type drive gears of the vertical edgers of the hot strip mill has proven to be quite troublesome due primarily to conditions of design. The gears are mounted in an exposed condition subject to considerable spray from the hydraulic water descaling system together with airborne contaminants. The preferential wetting of the gear tooth surface with the water from the descaling sprays tends to prevent proper adhesion of the gear lubricant when applied by pouring from a dipper or bucket while the gears are revolving. This method has been conventional practice for applications of this type in the steel industry.

In evaluating the merits of this problem it was desired to develop some means of automatically spraying the heavy duty type gear lubricant in measured quantities at predetermined cycles of application. In addi-

Figure 3 — A heavy duty lubricant is ordinarily sprayed on the gears.



tion it was believed necessary to apply the lubricant at a velocity of impingement sufficient to permit replacement of the film of water at the interface of the gear tooth surface. An air line supply pressure of ninety to one hundred psi has proven to be adequate in this regard.

For purposes of simplification it was further planned to incorporate the same type lubricant for lubricating the plain bearings of the edger as well as the bevel gears themselves. The system employed is essentially a motor-driven completely automatic time clock operated grease system of approximately twenty-five pounds capacity. The lubricant is pumped at predetermined time intervals from the central station through strategically located adjustable measuring dispensing valves to the ultimate point of application. The dispensing valve utilized for the spray application of the lubricant on the bevel gears differs from the conventional measuring valve in that it has an attached air control valve through which both the lubricant and the air are discharged via separate discharge lines to a common spray nozzle. The lubricant is ejected through a center tube in the spray nozzle slightly in advance of the discharge orifice. The air supply in this case picks up the lubricant upon its discharge from the center supply tube and atomizing it during its travel through the discharge orifice.

Although this system has been utilized for a relatively short time the improvements noted to date with both the bearings and the bevel gears have proven to be sufficient to warrant this system being made to include both the vertical edger units. Other applications which we intend to investigate in the near future wherein this type of spray application would be employed are the line shaft bevel gears of the furnace and approach tables of the strip mill, and tilting table line shaft gears and bearings of the two stand three high plate mill.

LUBRICATION OF CONVEYOR CHAINS

In the past we have been confronted with an excess loss of lubricant together with a very unsightly operating condition in the lubrication of conveyor chains. The most common method used in applying the lubricant was to attempt to pour the lubricating oil on the linkage of the chain while it was moving slowly. As might be expected, the greater quantity of lubricant being applied in this manner did not actually come in contact with the linkage as desired, but rather covered the surrounding tables, guides, or was lost to the conveyor pit itself.

The accumulated oil in this case acted as a nuclei for scale and general mill debris and as such, posed an added fire hazard to the general poor housekeeping conditions.

In order to apply the lubricating oil to the desired point of application of the chain linkage, some method had to be developed to permit the spray cycle to be actuated at the same time that the chain linkage was located properly in proximity to the spray nozzle discharge.

One method which has proven to be successful for applications of this type incorporates the fitting of allen set screws on the sprocket wheel, concentric with the drive shaft and spaced to permit tripping of the trigger contact arm. The allen set screw spacings in this case are provided to permit the desired actuation of the spray nozzle at the same time that the point of application of the chain linkage is directly in front of the nozzle. Inasmuch as most chain linkage is of uniform center to center pin spacing this method is found to be quite feasible.

A minimum of contact with the trigger contact arm is all that is necessary to insure efficient lubrication despite the speed of chain travel. Oil feed can be controlled by providing some means of adjustment in the spray nozzle valve or by means of a regulated air pressure and selected spray nozzle orifice size. An oil reservoir of most any given size can be incorporated in conjunction with a spray system of this type commensurate with the requirements encountered with the different field applications. Where graphite type compounds are employed, it has been found to be necessary to use colloidal admixtures of the graphite in oil.

BLOOMING MILL SCREWDOWN SCREW AND NUT LUBRICATION

Our past experience in the lubrication of the screws and nuts of our blooming and slabbing mill entailed manual application via a bucket from a port of entry on the top of the screwdown housings. This method of

Figure 4 — Mechanism was set up so that the chain linkage was sprayed at the time when it was at the proper location.

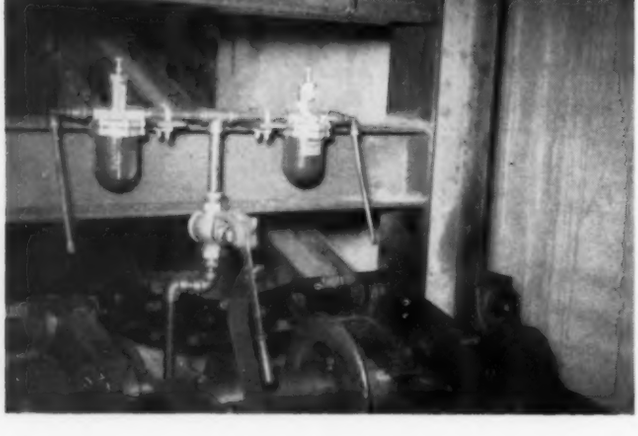


Figure 5 — A satisfactory protective guard is necessary to prevent entry of scale into the bearing.

application tended to provide overlubrication with an attendant loss of oil from the bottom of the nut with poor housekeeping conditions. Unfortunately this period of overlubrication soon dwindled to a point where inadequate lubrication was noted. As such it was found that this method of feast or famine lubrication sufficed with the aforementioned limitations to provide lubrication of the screw in one direction of travel only. Inasmuch as no point of lubricant pickup was available when the screw was moving in the up direction, the only lubrication furnished thereby was that portion which adhered to the screw at the end of its downward travel. One of the more noticeable end results of this adverse condition was the tendency for the nut to develop a bell mouth type of wear. As this wear condition progressed, the excess loss of lubricant seemed to be aggravated proportionately.

In evaluating this problem it was our intention to provide, if possible, a method of lubricating the screw during its travel in both directions. After several methods of meeting this situation were reviewed it was decided to apply four separate points of lubricant entry into the base of the nut thread, spaced at predetermined locations to permit the reformation of the lubricant wedge action between the mating thread surfaces of the steel screw and bronze nut within the running length of the nut proper. A mild relief was provided at the discharge opening of the grease hole and nut thread to minimize the resistance to lubricant flow. The lubricant supply piping is installed in holes slotted in the outer surface of the nut and securely mounted by pipe threads in the outer end of the port of lubricant entry. The other end of the four supply pipes extend below the bottom of the nut to permit the connection with lubricant supply tubing which are in turn connected to measuring valves of an automatic type lubricating system. Grease has been utilized as the lubricating medium in this case. It was felt that the selection of grease would provide added features of sealing, greater retentive qualities and better lubricant control from the standpoint of consumption, as compared to utilization of oil for this type of application.

COMPOSITION BEARING AND SCALE GUARD INSTALLATIONS

Our experience in the application of composition bearings in the roll train of the hot strip mill, rollneck bearing of the two-stand, three-high plate mill and the rollneck bearings of the blooming and slabbing mill has been quite varied in the past. This inconsistency in end results has prompted several experiments being conducted to ascertain what might prove to be the most satisfactory method of composition bearing application for our operations.

As most generally accepted, the original installation of composition bearings in both the roll stands of the hot strip mill and in the blooming mill included a minimum change of design of the existing chucks. This method of approach was soon proven to be erroneous in that relatively short bearing service life was realized. Further study of the problems noted indicated that certain fundamentals were violated in the original bearing installations which had to be corrected to obtain satisfactory bearing life.

In the utilization of the existing chucks for mounting the rollneck bearings of the hot strip mill, it was found that improper seating of the bearing in the chuck existed. As the composition material possessed no measurable tendency to compress, the excess clearance between the bearing and chuck allowed the bearing material to either spread or close in. The former condition resulted in lowering of the bearing contract area with accelerated bearing wear. The latter condition promoted excess bearing wear as the result of the tendency for the bearing material to grip the rotating rollneck. Where an uneven bearing seating surface was encountered it was found to aggravate these adverse conditions.

While the compressive strength of this type bearing material is very high, in the range of 37,000 to 38,000 psi, it is imperative that proper seating of the bearing in the chuck is provided to prevent distortion. All chucks in which composition bearings are installed should be machined finished to fairly close tolerance limits, within a plus or minus of 0.003 in.

Subsequent installation of new chucks in our hot strip mill where proper seating has been provided has offered an increased bearing service life expectancy.

Our experience in this regard has shown a rather phenomenal service life increase (from approximately 4,000 tons to approximately 165,000 tons). It was noted that the latter installation also developed a tapered wear condition on the top bearing only. The screw center line in this case is slightly off the center line of the top bearing chuck assembly and it is presumed that the tapered wear noted has resulted therefrom.

The original installation of composition bearings in the blooming mill incorporated the existing chucks filled with babbitt to the final radii dimension. Usage of the soft compressible babbitt metal proved to be unsatisfactory in that it did not offer adequate support to the composition bearing liner, permitting distortion to take place with corresponding loss of bearing life. Subsequent installations have included the mounting of the composition bearing liners in steel chucks machined to the desired tolerances.

Another problem which proved to be of considerable importance for deriving satisfactory service life with composition bearing installations was that of providing an ample supply of water.

A spray pipe design was developed to permit standardized spacing and orifice size. The length of the spray pipe in all cases is provided to assure full coverage of the rollneck and the adjacent thrust collar. The spray pipe diameter employed in the strip mill and plate mill is $\frac{3}{4}$ in. whereas the blooming mill is one in. in diameter. The center-to center spacings employed for the openings in the spray pipes is approximately two in. with the exception of the first orifice from the end being approximately $\frac{3}{4}$ in. The orifice adapted is $\frac{5}{32}$ in. diameter and is staggered to permit a spray angle of approximately 30 degrees from the center line of the spray pipe. An auxiliary hole is drilled in the end of the spray pipe at 45 degrees to provide water for the fillet of the roll. The spray pipes are adjusted so that the water hits as high as possible on the roll necks to allow for maximum cooling. On our mill installations, at least, water pressure of approximately twenty psi at the

Figure 6 — Composition bearing and scale guard assembly for plate mill is here shown.

Figure 7 — Illustration shows details of composition bearing and scale guard installation for plate mill.

spray pipe outlets is necessary to obtain the desired bearing service life. Where the water pressure has been found to fall appreciably below the twenty psi pressure, which we consider an optimum, a decided loss of bearing service life has been noted. It is also believed mandatory to provide suitable water strainers in the supply lines to prevent clogging of the spray pipe openings. At the present time, we are employing strainers with approximately $\frac{3}{64}$ in. mesh. It is understood that the size of mesh should be commensurate with field conditions encountered. It is also believed to be advantageous to install the spray pipe headers in such a manner as to permit proper positioning of the spray outlet water at all times. To provide this feature on our installations, the spray pipes are welded to a keeper bar which in turn are mounted on the chuck assembly by means of two cap screws.

Of equal importance to the proper mounting of composition bearing inserts and conditions of the roll neck itself is the need for a satisfactory protective guard to prevent the entry of scale into the work zone of the bearing. This very often proves to be a major problem in that the guard by necessity must be light enough in construction to facilitate installing and removing it manually as required. Where the construction of scale guards results in heavy unit weights, considerable resistance has been encountered from mill personnel whose duties include the handling of it. On the other hand where the construction has been on the light side, considerable damage has been noted with routine handling. At best the most satisfactory scale guard is a compromise which will be readily handled by mill personnel and yet heavy enough to resist normal rough handling. Several types of scale guard designs have been employed to date. The design which has proven to be most satisfactory in our case is constructed to permit usage of a sealing ring of composition material which is butted up against the end of the roll barrel. The sides of the scale guard are extended down far enough over the bearing proper to prevent the entry of scale particles which have been retained within the housing posts and which tend to be reduced to a very small particle size by crushing in the movement of the scale guard as a result of the shock loading imposed by mill rolling operations. In order to prove the merits of installing a suitable scale guard, a test was conducted on one of the stands of the roughing mill section of the hot strip mill. The results obtained therefrom showed a very satisfactory roll neck condition on the side where the scale guard was installed, whereas on the other end of the same roll, considerable scuffing of the roll neck was encountered. Constant follow up on the part of mill operating personnel to insure proper mounting of the scale guards is believed to be mandatory for realization of the benefits offered thereby.

DISCUSSION

PRESENTED BY

H. J. LeBECK, Sales Engineer, Ryertex Div., Joseph T. Ryerson and Son, Inc., Philadelphia, Pa.

LOUIS MOSES, Mill Engineer, Bethlehem Steel Co., Bethlehem, Pa.

H. H. ANGEL, Electrical Engineer, Construction and Engineering Dept., Bethlehem Steel Co., Bethlehem, Pa.

C. H. DUNN, Technical Coordinator, United States Steel Corp., Fairless Hills, Pa.

WILLIAM KOWALSKY, Chief Mechanical Engineer, Ramseyer and Miller, Inc., New York, N. Y.

R. G. LEISTER, Lubrication Engineer, Alan Wood Steel Co., Conshohocken, Pa.

H. J. LeBeck: In the composition bearings I would like to know what was done with filled greases in the lubrication system the author used in the composition bearings and what his results were.

H. H. Angel: I have heard some comments lately in reference to the life of fabric bearings on blooming mills, most important being the fine fitting scale guards to keep out scale and dirt, and the necessity for ample water in connection with the lubrication of the fabric. Mr. Leister gave us some information on the size fittings for the water pipes and stated about 20 psi of water pressure was used.

I would like to ask him whether he has experimented using higher pressure and if so, what the results have been.

C. W. Dunn: I would like to ask what size force is maintained in the central lubrication repair shop. Also, how do you coordinate this activity with mill personnel who are operating in a decentralized maintenance system?

William Kowalsky: I would like to find out more about the lubricating oil reclaiming system. We had a brief mention of such an installation in one of the illustrations but there were no details given. My questions are, at what point is it economical to install such a reclaiming system? Is it merely a filtration system? Is there a centrifuge involved, and is there chemical treatment?

R. G. Leister: To answer Mr. LeBeck's question, I can only state my experience with filled greases in respect to composition bearings. It can do a lot of good and also can do a lot of harm, depending on how much you apply. I recall the installation in our plate mill whereby we originally employed filled grease. Due to the various rollers stepping up the cycle on the automatic system, too much grease had a tendency to dam the water. So that now we are gradually getting away from the grease entirely. We are getting better results without the grease now.

As far as the size of the orifice and the high pressures, I have not experienced any higher pressures: I have gone up to 28 psi, but that is all. It seems that if we stay around 22 or 24 psi, we have much better results.

As far as our lubrication department set-up in the plant is concerned, we have a centralized maintenance department. Our department, in size, includes six repairmen and they work with the mill personnel. The six repairmen are strictly a daytime force, and they take care of all the lubrication equipment. At night time it depends on the nature of the work, if possible temporary repairs are made by mill personnel, otherwise a lubrication repairman is called out.

Within the last two years we have built an addition to the oil supply house and have installed a reclaiming unit. It has paid for itself within 13 months after installation. We also have in that building tanks, whereby we can blend some of the lighter oils for slushing purposes. We also own our own drums, due to the fact we lost 2000 drums in ten years. Each department is charged $7.00 for each drum it receives from the oil supply house. Drum control is better controlled now than ever before. We have separate drums for the reclaimed oil, we have separate drums for the used oil, with certain color codes. In reclaiming oils, we run it through canvass and cellulose material, removing dirt and water. We do not employ centrifuges or chemical treatment.

CURRENT AISE DISTRICT SECTION MEETING NOTICES

BIRMINGHAM SECTION

Friday, December 17, 1954

Christmas Dinner and Dance

Cocktail hour 6:30-7:30 P.M.

Dinner 7:30-9:00 P.M.

Dancing 9:00-12:00 Midnight

Thomas Jefferson Hotel, Birmingham, Ala.

BUFFALO SECTION

Friday, December 3, 1954

Christmas Dinner and Dance

Hotel Statler, Buffalo, N. Y.

CHICAGO SECTION

Saturday, December 4, 1954, 7:30 P.M.

Christmas Dinner and Dance

Hotel Congress, Chicago, Illinois

CLEVELAND SECTION
(WITH YOUNGSTOWN SECTION)

Saturday, December 4, 1954

Christmas Dinner and Dance

Dinner 7:30 P.M.

Dancing 9:00 P.M-1:00 A.M.

Rainbow Room, Hotel Carter, Cleveland, Ohio

DETROIT SECTION

Saturday, December 4, 1954

Christmas Dinner and Dance

Detroit Yacht Club, Belle Isle, Detroit, Mich.

PHILADELPHIA SECTION

Saturday, December 4, 1954 — Dinner 6:00 P.M., Meeting 7:00 P.M.

"Handling Bulk Materials in Steel Plants," by A. H. Andrews, Special Engineer, Construction Engineering Dept., Bethlehem Steel Co., Bethlehem, Pa.

"Modernization of Alan Wood 84-In. Plate Mill," by T. H. Williams, Assistant to Chief Engineer, Alan Wood Steel Co., Conshohocken, Pa.

Engineers' Club, 1317 Spruce Street, Philadelphia, Pa.

PITTSBURGH SECTION

Friday, December 17, 1954

Christmas Dinner and Dance

Dinner 7:30 P.M.

Dance 9:30 P.M.

Hotel William Penn, Pittsburgh, Pa.

ST. LOUIS SECTION

Friday, December 17, 1954

Christmas Dinner and Dance

WESTERN SECTION

Tuesday, December 7, 1954 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"The Role of Industry in Air Pollution," by William C. Estler, Director of Public Relations, Stanford Research Institute, Stanford, Calif.

Villa de la Paix Restaurant, 116 Sixth Street, Oakland, Calif.

YOUNGSTOWN SECTION
(WITH CLEVELAND SECTION)

Saturday, December 4, 1954

Christmas Dinner and Dance

Dinner 7:30 P.M.

Dancing 9:00 P.M. to 1:00 A.M.

Rainbow Room, Hotel Carter, Cleveland, Ohio

AISE DISTRICT

EMMETT A. MAYHALL
BIRMINGHAM DISTRICT SECTION

EMMETT A. MAYHALL was born in Double Springs, Ala., educated in public schools of Alabama and Tennessee, and graduated from the University of Cincinnati in 1929 with a degree in Electrical Engineering. Upon graduation he was employed by the Cincinnati Street Railway Co. in the Substation and Research Depts. In 1936 he joined the Tennessee Coal and Iron Division of the United States Steel Corp. as a draftsman in the electrical engineering department, and subsequently became checking engineer. As a reserve officer, he was called to active duty in 1942, served four years and was returned to inactive duty with the rank of lieutenant-colonel. He is now employed as an electrical engineer in the electrical engineering department of the Tennessee Coal and Iron Division of the U. S. Steel Corp.

FRED T. VAN CAMP
BUFFALO DISTRICT SECTION

FRED T. VAN CAMP was born in Syracuse, N. Y. where he attended grade and high school. He attended Syracuse University and later took Syracuse and Cornell extension courses. He attended night classes at University of Buffalo for two years. He worked for the John Deere Plow Co. at Syracuse and Central New York Power Co. He entered the employ of Crucible Steel Co.'s Halcomb Division in Syracuse in 1934. He went to Buffalo in 1943 as general foreman of rolling mills, Wickwire Spencer Steel Co., now the Wickwire Steel Division of Colorado Fuel and Iron Corp. He was appointed rolling mills superintendent in 1948, the position now held.

N. R. KIRKDOFFER was born in 1903 at Milford, Ind. He graduated from Purdue University in 1928 with a B.S. in Electrical Engineering. He was hired at Inland Steel Co. in June, 1928 as a test engineer in the electric and power departments. He advanced to electrical foreman in 1931 and to assistant general foreman in 1944. In 1946 he was promoted to assistant superintendent of the electric and power departments and in 1947 to assistant superintendent of the electric, power and steam departments. In 1950 he was promoted to superintendent of the power and steam departments.

E. C. McDONALD received his elementary schooling in Duquesne, Pa., and graduated from the University of Pittsburgh in 1922, with a degree in metallurgical engineering. His first position after graduation was with Carnegie Steel Co. in Duquesne as a test engineer in the fuel and experimental department. In 1926 he accepted the position of assistant combustion engineer of Donner Steel Co. in Buffalo, N. Y. Donner Steel was combined with Republic Steel Corp. in 1930, and shortly thereafter Mr. McDonald was made Buffalo district combustion engineer. When Corrigan-McKinney Steel Corp. was merged with Republic in 1935, he was transferred to Cleveland as chief combustion engineer, holding that position at the present time.

HAROLD C. HOEFT was born in 1915, in Pontiac, Mich. He was educated in the Detroit Public Schools and studied electrical engineering while attending Wayne University. He started his employment with Great Lakes Steel Corp. in 1935, working in the electrical construction and electrical maintenance departments. In 1941, he was transferred to the electrical engi-

N. R. KIRKDOFFER
CHICAGO DISTRICT SECTION

E. C. McDONALD
CLEVELAND DISTRICT SECTION

HAROLD C. HOEFT
DETROIT DISTRICT SECTION

CHAIRMEN 1954-1955

neering department and the promotion to his present capacity of assistant chief electrical engineer was made in 1947.

C. E. DUFFY was born in Baldwinsville, N. Y., and after completing high school attended Clarksons College of Technology where he received a B.S. in Mechanical Engineering. In June 1926, he entered the Bethlehem Steel Corp.'s loop training course at Bethlehem, Pa., and in September of the same year was transferred to the fuel department of Bethlehem's Sparrows Point Plant to assume the duties of testman. He became the assistant fuel engineer of the fuel department in 1930, and fuel engineer in 1948.

JAMES N. IMEL was born at Cambridge Springs, Pa. in the year 1907. He received his elementary and high school education in Cleveland, Ohio and was graduated from Bethany College, Bethany, W. Va. in June 1930. He started to work with the Jones and Laughlin Steel Corp. shortly after his graduation as a student trainee. After holding various jobs in the rolling mills department, he was advanced to the position of general foreman, D. S. mills in 1937. In April 1946, he was promoted to the position of assistant superintendent of rolling mills, and on August 1, 1947 was appointed superintendent of rolling mills, Pittsburgh works. He is now superintendent, sheet and strip departments, Jones and Laughlin Steel Corp., Pittsburgh, Pa.

NELSON L. ARMITAGE was born in Bergholz, Ohio and attended schools in Steubenville, Ohio. He was first employed at Follansbee Brothers in Follansbee, W. Va. He next spent twenty-one years with Wheeling Steel Corp. in Steubenville, Ohio working on the bar mill and soaking pits. He went with Granite City Steel Co. in May 1951 as soaking pit foreman, his present position.

W. A. MARSHALL, a native of Pennsylvania, graduated from Penn State in 1915. He started with United States Steel Corp. (American Sheet and Tin Plate) in 1916. Since then he has been in engineering and maintenance work at New Castle, Wellsville, New Kensington, Vandergrift and Irvin. He went to Columbia-Geneva Steel Division of the United States Steel Corp. in 1948. He is now works engineer at Pittsburg, Calif. works.

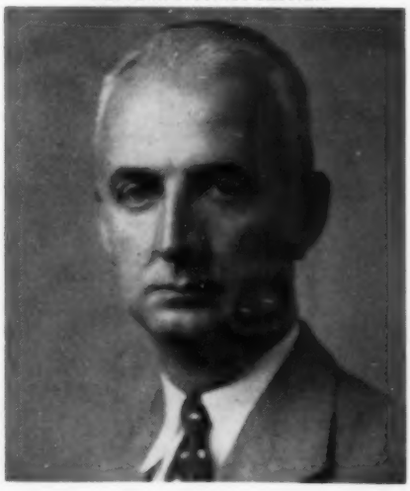
W. W. JUSTICE, a Pittsburgher by birth, attended Carnegie Institute of Technology, receiving an M.S. Degree in Mechanical Engineering in 1933. He then started work at United States Steel Corp.'s Duquesne Works as a power and fuel engineer, transferred to the Pittsburgh office as an industrial engineer in 1937, and became a project engineer in the Youngstown district in 1941. In the spring of 1943 he went into operations, successively being responsible for operation of the narrow gage, service, and operating maintenance departments. In 1952 he was appointed assistant division superintendent of the blast furnaces and in 1953 chief engineer, Youngstown district.

C. E. DUFFY
PHILADELPHIA DISTRICT SECTION

JAMES N. IMEL
PITTSBURGH DISTRICT SECTION

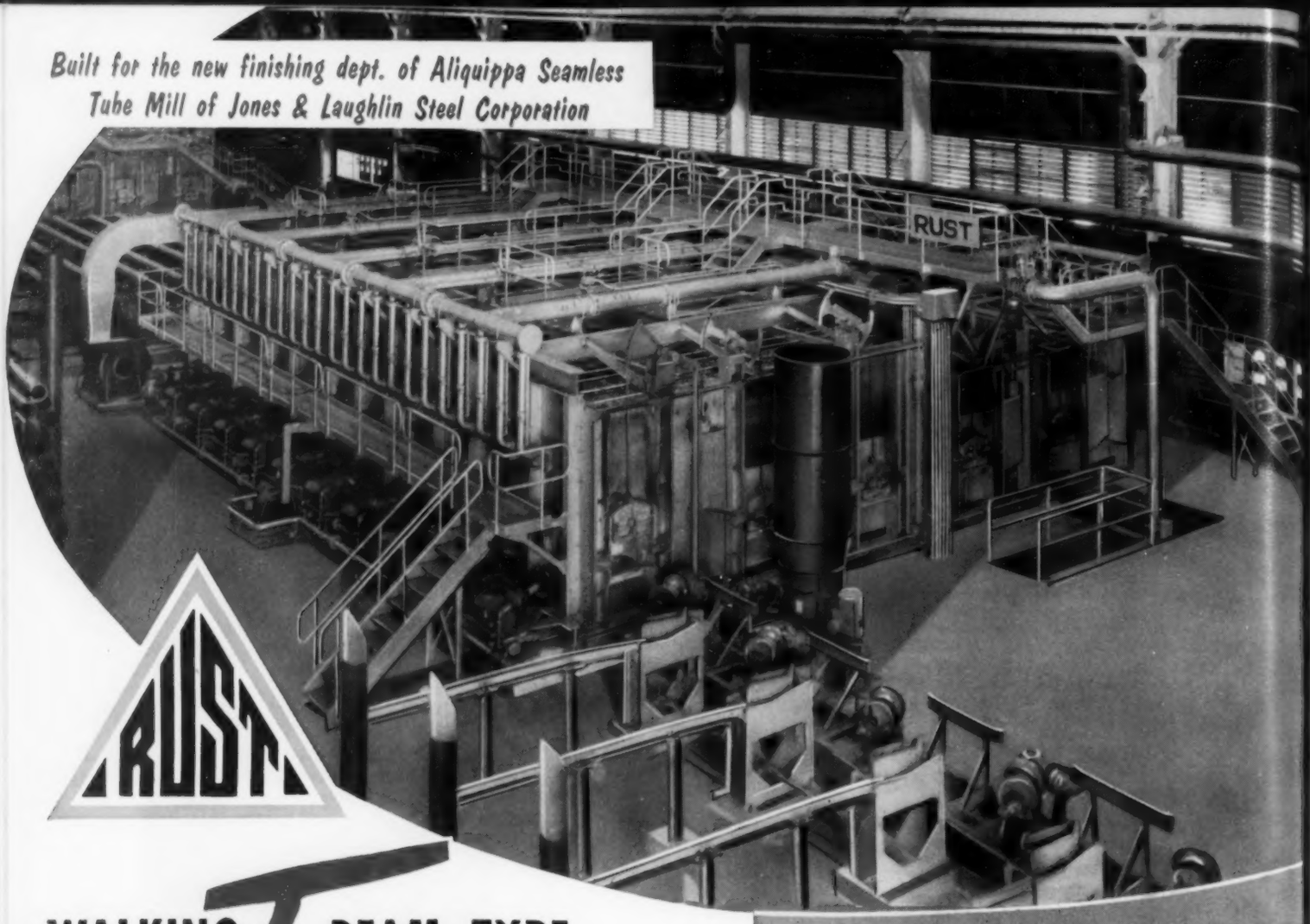
NELSON L. ARMITAGE
ST. LOUIS DISTRICT SECTION

W. A. MARSHALL
WESTERN DISTRICT SECTION



W. W. JUSTICE
YOUNGSTOWN DISTRICT SECTION

Built for the new finishing dept. of Aliquippa Seamless Tube Mill of Jones & Laughlin Steel Corporation



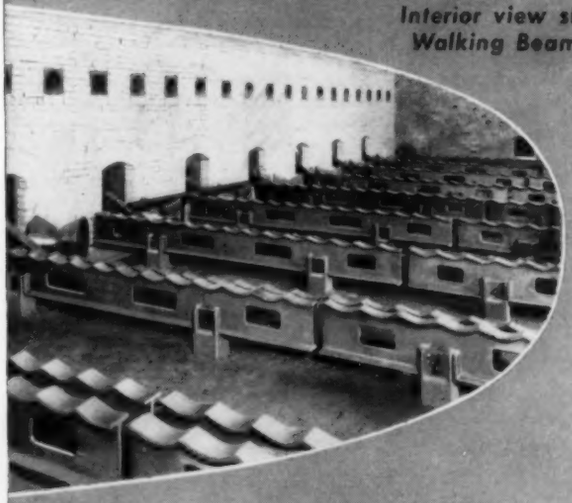
RUST

WALKING BEAM TYPE HEAT TREATING *Furnaces*

For heat treating their seamless tubing, the Jones & Laughlin Steel Corporation chose two specially-designed Rust furnaces as shown above. These walking beam type furnaces were designed and constructed by Rust in record breaking time—and they are helping the new "J & L" Seamless Tube Finishing Department to break records in producing, conditioning, and finishing high tensile strength seamless tubes.

Be sure to consult Rust on any problem of tube and pipe annealing, heat treating, and processing. Rust also designs and builds other type furnaces to meet every metallurgical heating need.

Interior view showing Walking Beam Rails



FIRST *installation of this type for Normalizing, Quenching and Drawing of Seamless Tubes*

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One contract covers everything, from original idea to start-up. One responsibility for design, manufacture, erection and initial operation. One overhead and profit (with substantial savings to you) on all phases

Rust Furnace Company

Pioneers in Furnace Design

Rust Building • Pittsburgh, Pa.

Multiple-Package Power and Control for Processing Lines

By E. E. VONADA
Application Engineer
Reliance Electric and Engineering Co.
Cleveland, Ohio

▲DURING the past 15 years, one of the most remarkable signs of technical progress in the steel industry has been the development of continuous strip processing lines. Universal acceptance of lines for pickling, cleaning, annealing, plating, shearing and slitting sheet steel is in evidence today.

Because of the development of these continuous processes, the cost of producing steel products has been dramatically reduced so that every possible use of strip and sheet is now within the economic reach of all manufacturers. Electrical developments in the engineering of steel mill drives have kept pace with mechanical progress.

Processing line sections were initially powered from a common generator (Figure 1) with few boosters and regulator systems. Synchronization of units became more complex as the demand for faster line speeds and the inclusion of additional processes in continuous arrangement became necessary. Additional booster generators were required to assist in synchronizing all units in a section.

Then began the trend to provide each drive motor with its own generator (Figure 2). Sound engineering of generators with respect to design of main and auxiliary fields provided simplification and greater flexibility of the drive system. In fact, individual generators have proven so successful, that it is no longer considered necessary in an adjustable-voltage system to operate drives from a common generator.

It was in 1948, while analyzing the constant torque requirements for an electrolytic tinning line, that it became apparent to our engineers that the simplest, most expeditious method for providing adjustable voltage power to the many driven units in the line would be to apply individual generators to each unit or small group of units adjacent to each other.

This system was a distinct departure from the conventional arrangement previously employed whereby the entry, center and delivery sections were each supported by an independent generator, and boosters were added where necessary to assure proper synchronization of line speed. Completion of comparative drive data showed that the new independent generator system was less expensive, not only because of the higher speed generators and fewer control devices involved, but also because actually one less commutator was required.

Standard practice of steel mill engineers for many years has been to put motor-generator sets and controls in isolated motor rooms.

Five years ago some users elected to arrange the individual generator motor-generator sets adjacent to each process line section and thereby reduce installation costs by eliminating long cable runs.

Recently another group of engineers have installed packaged motor-generator sets and controls right next to the process unit drive motors. Packaged drives were first introduced sixteen years ago by the Re-

Figure 1 — Runout table motor-generator sets and controls are installed in a central motor room separately located from run-out table drive motor.

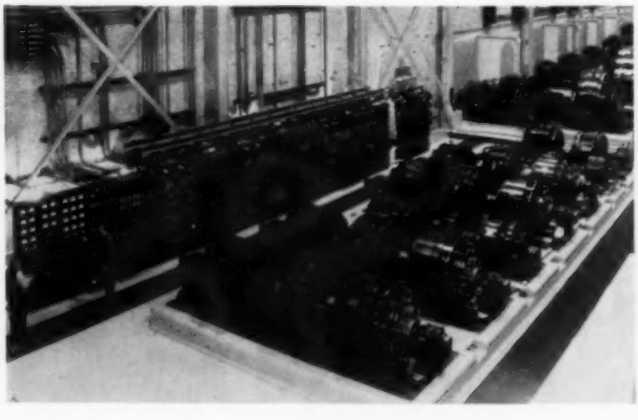


Figure 2 — Motor-generator set consists of individual section generators mounted close to processing line drive units.

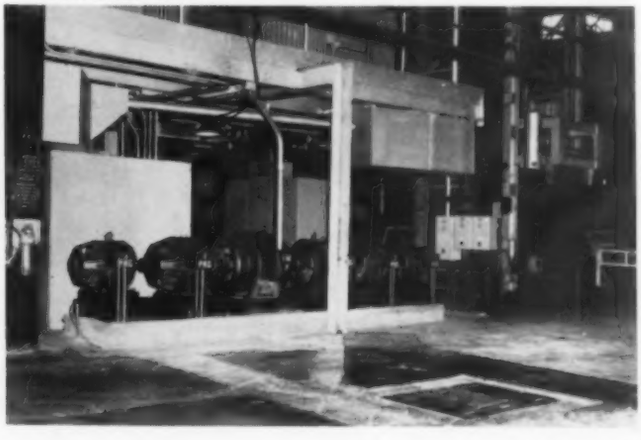


Figure 3 — High speed slitting line with packaged drive control units are located near drive motors.

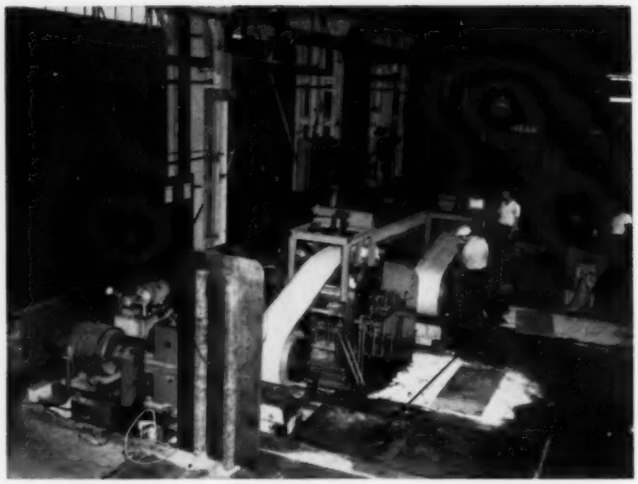


Figure 4 — Two-strand pickle line rewind reels and pinch rolls are powered from V-S drive units in background.

liance Electric & Engineering Company.

These packaged drive units, containing the motor-generator set, controls and regulators have been provided at a lower cost per installed horsepower and have many advantages over previous power systems. The elimination of heavy cable runs from motor rooms to drive motors is an important cost reduction item as control units are installed adjacent to process units (Figures 3 and 4). All interconnecting wiring between generating equipment and control is done at the factory, thus reducing installation costs. External wiring for this system employs only a series of light control wires between units and power leads to specific drive motors.

Another advantage of assembled rotating equipment and controls is the combination testing at the factory, minimizing field checking and start up time.

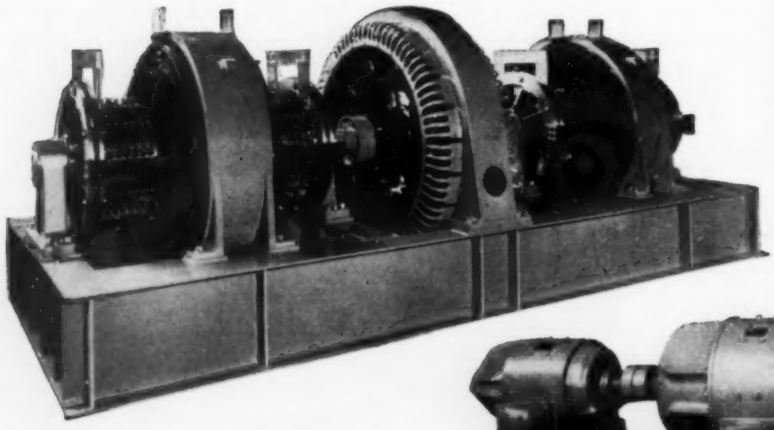
The steel industry is now applying packaged V*S Drives to many types of processing lines.

All of the advantages of packaged motor drives are now working for better strip steel processing lines. Besides compactness, packaged drives are neat, well-arranged for easy maintenance and inspection and have few restrictions as to placement.

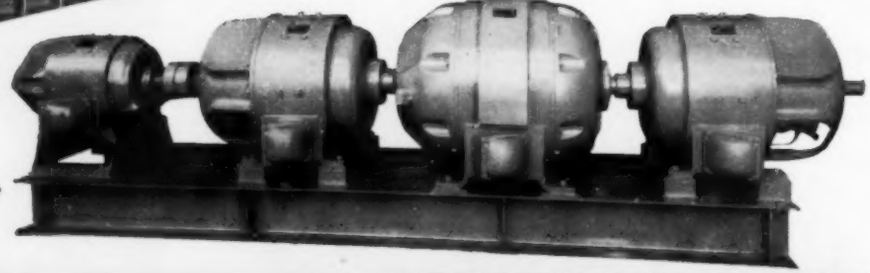
COLUMBIA

MOTOR GENERATORS

Whether it be for continuous electrolytic tin-plating or electrocleaning lines, or for special power needs, Columbia builds Motor Generator Sets for your individual requirements. They're giving superior, around-the-clock performance in many of the country's leading mills. Illustrated here are typical installations of Columbia generators built to specification.



Two 7500 Ampere 24 volt, 3750 Ampere 48 volt, Separately Excited, Columbia D.C. Generators driven by 600 HP, 1.0PF, 360 RPM Synchronous Motor.



Multi-Unit Columbia Motor Generator Set consisting of two 50 KW, 250 Volt, D. C. Generators, and one 10 KW, 50 Volt, 200 Ampere booster Generator, all driven by 200 HP, 0.8PF, 1200 RPM Synchronous Motor.

COLUMBIA ELECTRIC MFG. COMPANY

4543 Hamilton Avenue Cleveland 14, Ohio

you can cut your peel costs 50% with univan castings

UNION PEELS
cast in nickel UNIVAN steel

There are cases on record where UNIVAN peels are lasting two to three times the life of carbon peels . . . and in some cases even longer. For UNIVAN steel, compared with carbon steel, has greater resistance to firecracking and greater resistance to torsional twist and shock.

When you consider what this longer life can mean to you in terms of fewer castings . . . less machining—and the cost of machining may equal the original cost of the casting . . . and less downtime . . . the net result could be even more than a 50% saving.

So check the life of your peels. And if you're not satisfied, give UNIVAN peels a chance to prove how they can perform on your toughest jobs. Likewise, for your charging boxes, bearing covers, couplings and spindles, tongs and levers . . . as all of them are available in this special alloy steel.

Write us for complete information. Or send your blueprints for a prompt quotation on your requirements . . . for castings in the rough or completely machined.

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PITTSBURGH 1, PENNSYLVANIA

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UNION PRODUCTS: charging boxes • peels • bearing covers • slag pots • tongs and tong levers • universal couplings and spindles • gears and pinions • ingot cars • charging box cars • special UNIVAN and ARMOR steel castings.

Proven On loads *UNDER* 600 Amps . . . .

Fusetron dual-element Fuses Have an Interrupting Rating in Excess of 100,000 Amps.

An interrupting rating in excess of 100,000 amperes for FUSETRON dual-element fuses . . . this was shown by tests that were conducted under conditions that simulated the most severe field conditions. These tests were witnessed and verified by the Electrical Testing Laboratories of New York.

The test circuits were set to deliver far in excess of 100,000 amperes — yet the 250 and 600 volt FUSETRON fuses cleared the shorts without igniting readily flamable material placed around the fuses . . . and there was comparatively little noise.

These tests show that Fusetron fuses, even in the small 30 ampere range, can interrupt safely the most severe available short circuit current.

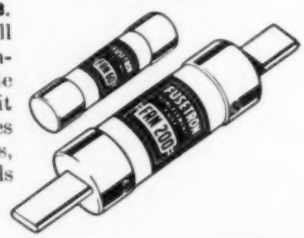
No interference with time-lag

Time-lag is of utmost importance to give proper motor and electrical protection and to eliminate needless blowing of fuses. Even though the interrupting capacity has been greatly increased, the time-current characteristic of Fusetron fuses has in no way been disturbed.

ALL THIS ADDED SAFETY

without changing a panelboard or switch . . . plus 10 point Protection of FUSETRON dual-element FUSES!

1. Protect against short-circuits. **2.** Protect against needless blows caused by harmless overloads. **3.** Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation. **4.** Provide thermal protection — for panels and switches against damage from heating due to poor contact. **5.** Protect motors against burnout from overloading. **6.** Protect motors against burnout due to single phasing. **7.** Give double burnout protection to large motors — without extra cost. **8.** Make protection of small motors simple and inexpensive. **9.** Protect against waste of space and money — permit use of proper size switches and panels. **10.** Protect coils, transformers and solenoids against burnout.



Fusetron Fuses Help eliminate needless Shutdowns for Production Engineers.

Work stoppages caused by needless blows are prevented. Even if all the motors on a circuit start at one time or other harmless overloads occur, the fuse link holds to prevent a shutdown.

Likewise, Fusetron fuses guard against needless blows caused by excessive-heating in panelboards and switches—lesser resistance results in cooler operation.

Fusetron Fuses Offer Maximum Safety for Electrical and Safety Engineers.

With an interrupting rating of 100,000 amperes, Fusetron fuses give the greatest possible protection against damage due to short-circuits. And just as important, they reduce the hazard of motor burnouts due to single phasing and overloading.

Fusetron Fuses Save Time and Work for Maintenance Engineers.

Once properly installed, Fusetron fuses require no costly inspection time or down-time for calibration and other maintenance necessary on mechanically operated devices.

Unnecessary repair work on motors is avoided because Fusetron fuses reduce to a minimum the danger of damage due to electrical faults. If trouble occurs, instead of rewinding or replacing burned out motors, simply replace Fusetron fuses.

Switches and panelboards are protected against damage from poor contact heating.

Fusetron fuses also protect against needless blows that cause irritating interruptions of regular maintenance.

Proven On loads *ABOVE* 600 and up to 5,000 Amps.

BUSS Hi-Cap Fuses Have an Interrupting Rating In Excess of 100,000 Amps. . . *and their blowing time can be coordinated with that of Fusetron fuses.*

An unlimited interrupting rating for BUSS Hi-Cap fuses on any voltage up to 600 . . . this was confirmed by tests reported by the Electrical Testing Laboratories of New York.

BUSS Hi-Cap fuses are designed to give protection against dangerous overloads as well as high fault currents — yet retain the speed of operation necessary to limit heavy short currents to safe values.

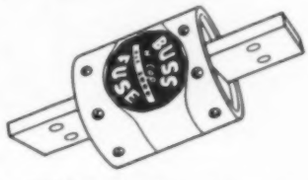
When coordinated properly with Fusetron dual-element fuses they will not open ahead of the fuse nearest to the fault — thus the trouble is isolated to the part of the circuit in which the fault occurs.

Added SAFETY on Old Installations

On installations where the increase in the capacity of the circuit has outgrown the interrupting rating of the circuit breakers, BUSS Hi-Cap fuses offer a safe and relatively inexpensive way to protect inadequate breakers against rupture in event of bad fault.

ACTION THAT SAVES YOU MONEY

Don't risk losses. Delay may cost you far more than replacing every fuse with a FUSETRON fuse. By passing the word along that all purchase and stock records should call for FUSETRON dual-element fuses on loads up to 600 amperes — and BUSS Hi-Cap fuses on loads above that, you get action that begets money saving.



On New Construction tell your architect to specify this Safer, Better Protection.

Fusetron Fuses Cuts Cost for Top Management.

Cuts maintenance cost — Fusetron fuses are maintenance free.

Cuts motor repair cost — Fusetron fuses guard the motor, against damage due to overloading, single phasing, short circuits and other electrical faults.

Cuts production costs — Shutdowns due to needless blows are eliminated.

Cuts new installation costs — Smaller sizes can be used, therefore big savings can be made on switches and panelboards.

Cuts present installation costs — Fusetron fuses hold and won't open on starting currents so the need for larger panelboards and switches is often eliminated — and in many cases new motors can be added to the circuit without installing larger panelboards or switches.

Play Safe—Install Fusetron Fuses and BUSS Hi-Cap Fuses now!

For blowing time charts or more information on FUSETRON fuses and BUSS Hi-Cap fuses use coupon or write for bulletin FIS and HCS.

FUSETRON
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BUSS

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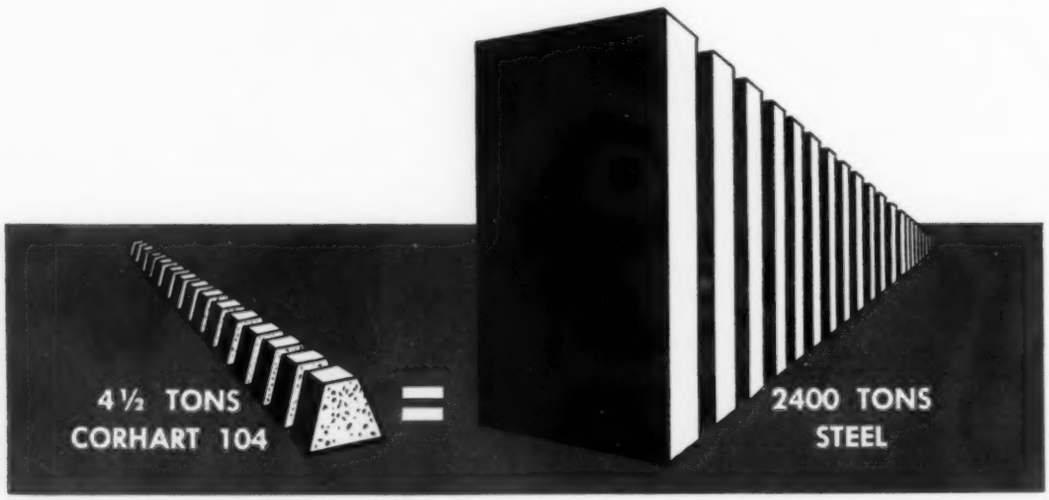
4½ Tons of CORHART 104 Give Producer 2400 Extra Tons of Steel!



CORHART 104 Electrocast Refractory is a completely new development by the pioneer of electrically-melted and cast refractories. Used in small amounts to fortify hot spots in electric furnaces and open hearths, it substantially prolongs furnace life and *lowers costs.*

For example. Until two years ago, one steel producer had been forced to shut down a 60-ton electric furnace after about every 100 heats, because of hot-spot failures in the walls. In those vulnerable areas they replaced 4½ tons of other refractories with Corhart 104 (12% of the unit's total sidewall refractory requirements) and immediately started averaging 32% longer life, with a 12% reduction in downtime for patching.

Corhart 104 is a new, different, magnesite-chrome refractory which is electrically-melted at 4500°F., and poured into its final shape. It possesses great resistance to slag erosion and spalling, and has high load strength with low porosity. Write for complete technical information. Corhart Refractories Company, *Incorporated,* 1602 West Lee Street, Louisville 10, Kentucky, U.S.A.

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CORHART 104 ELECTROCAST REFRACTORY

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ATLAS STEEL INCORPORATES MANY NEW DEVELOPMENTS IN EXPANSION PROGRAM

▲ATLAS Steels Limited, Welland, Ontario, is completing an expansion program intended to help make Canada self-sufficient in the production of stainless steel and to increase company efficiency in the manufacture of its tool and specialty steel products. The company is Canada's pioneer in the manufacture of tool steels and stainless steels in all forms except stainless steel castings, and the installation of strip and tube-making equipment rounds out its earlier production of stainless in light plate, sheet, bar, rod and wire forms.

The new facilities installed in the recent expansion include some of the most modern equipment, some even revolutionary in character, such as a continuous casting machine, a continuous powder scarfing machine, a "high-head" heating furnace for stainless slabs, a planetary hot strip mill, and numerous auxiliary units.

Six Heroult type electric furnaces, ranging 5 to 50 tons in capacity, are used to melt more than 200 kinds of specialty steels. The current program has involved the addition of some induction melting capacity for use in the firm's research work and for commercial production of smaller quantities of highly alloyed steels for the aircraft and similar industries.

In the past all steel produced has been cast into conventional ingots which are then hot worked on the blooming mill, 1000-ton press or 12,000-lb steam hammer.

The installation of continuous casting equipment makes possible the bypassing of the ingot casting process and will greatly reduce the number of passes necessary to produce slabs and billets.

The continuous casting machine was designed and built by Koppers under patents of Continuous Metalcast Co., Inc., while it is basically simple, successful operation depends on the control and perfect synchronization of metal temperature, speed of pouring and withdrawing the shaped metal, flow and temperature of cooling water in the mold and in the sprays below the mold, and synchronization of cutting torches and other mechanical equipment.

Briefly, the process is as follows:

Molten metal from electric furnaces is poured into a special 35-ton

Figure 1 — The continuous casting machine installed at Atlas Steels, Ltd. has four levels. Directly below the ladle, which has been lifted to the top of the machine, is the floor on which the mold and attendant equipment is situated. Below it is a floor where the cast metal is sprayed with water, and below this the pinch rolls. On the ground floor is the cut-off room. Below the cut-off room can be seen the pit from which cut-off pieces are brought back to floor level and pushed on the hot bed where drag conveyors move them to a pick-up cradle.

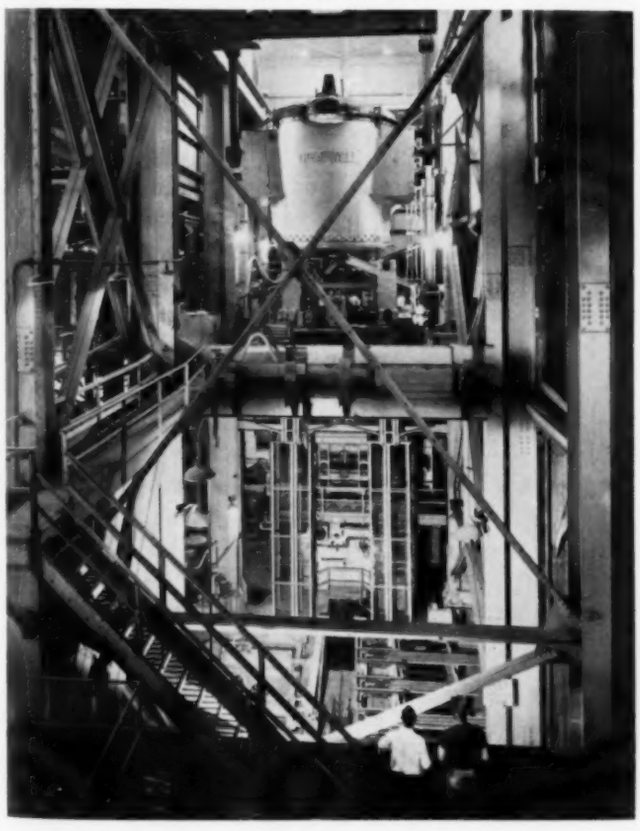


Figure 2 — Heart of the continuous casting machine is the continuous casting mold (directly in front of the two men), with hot metal being poured from the ladle through the tundish and into the mold. Some of the control equipment is shown at the left.

ladle lined with fire and insulating brick and pre-heated to 2400 F. When filled, this ladle is covered and transported by tram car to the front of the continuous casting machine. Here a crane picks it up, carrying it to the casting floor 31 ft above the ground and depositing it in a tilting cradle, automatically operated.

As the ladle begins to tilt, metal comes out of a special lipped spout which holds back any slag and pours into a tundish placed immediately

Figure 3 — Slab is being guided down through the pinch rolls, two floors below the casting area.

above the mold. This tundish acts as a metal reservoir and pouring box which the metal flows through a nozzle in a quiet stream into the mold.

At the start, the machine is "threaded" with a pre-formed starting bar, the top of which is inserted in the open bottom of the mold. Asbestos packing is inserted around the sides of this bar which has a bolt fastened to its top around which the first hot metal congeals, thereby fastening itself to the starting bar.

Approximately 20 seconds after the pouring has started, pinch rolls begin to turn, slowly withdrawing the starting bar with the newly formed hot billets from the bottom of the mold.

At the same time, synchronized machinery begins to oscillate the watercooled mold. In this oscillation, the mold moves downward, approximately ¾ of an inch, at the same speed as the bar, and then returns at a much greater speed to its original position, its sides sliding over the newly formed billet being withdrawn.

The liquid metal is at all times protected from oxidation with a gaseous atmosphere. Vegetable oil is constantly injected onto the inner perimeter of the mold to insure lubrication between the mold and newly cast bar.

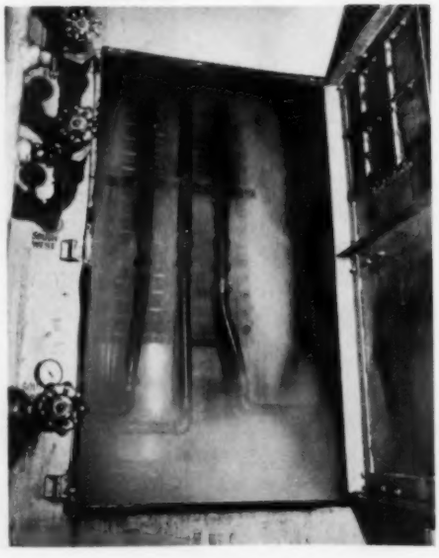
As the hot billet or slab moves downward through the next level of the continuous casting machine, it is rigidly contained by a suspended box whose sides are a series of small rolls. High pressure water sprays impinge upon the bar at this stage, to hasten the cooling.

On the level below, pinch rolls, carefully synchronized with the mold movement, lower the metal shape downward to the ground floor cutting chamber where, at measured intervals, two large oxygen cutting torches, which move downward with the bar, cut it into pieces of the desired length.

Cut off pieces are lowered into a pit and onto a carrier which brings them back to ground level and deposits them on a horizontal table equipped with a drag chain which slides the finished piece to a pickup cradle. From here, the continuous cast billets or slabs, now cooled down to approximately 1500 F, may be taken directly to reheating furnaces for rolling.

The amount of time required for each cast run depends, of course, upon the size of the heat and the size of billet or slab being cast. Atlas expects to operate the continuous casting unit on a 24-hour a day basis.

Figure 4 — Spray arrangement located immediately below the casting floor, sprays fine streams of water on the billet or slabs moving downward through guide rolls toward the cutting floor.



Already the machine of Atlas has cast 5½ in. x 7½ in. and 5½ x 21½ in. slabs. The machine is capable of casting any size of billet in the general range between 4 in. x 4 in., and 6 in. x 24 in., by using the proper mold. Length of billets or slabs thus cast is limited only by the availability of hot metal. For practical usage, however, automatic oxygen torches cut pieces into required lengths up to 16 ft long.

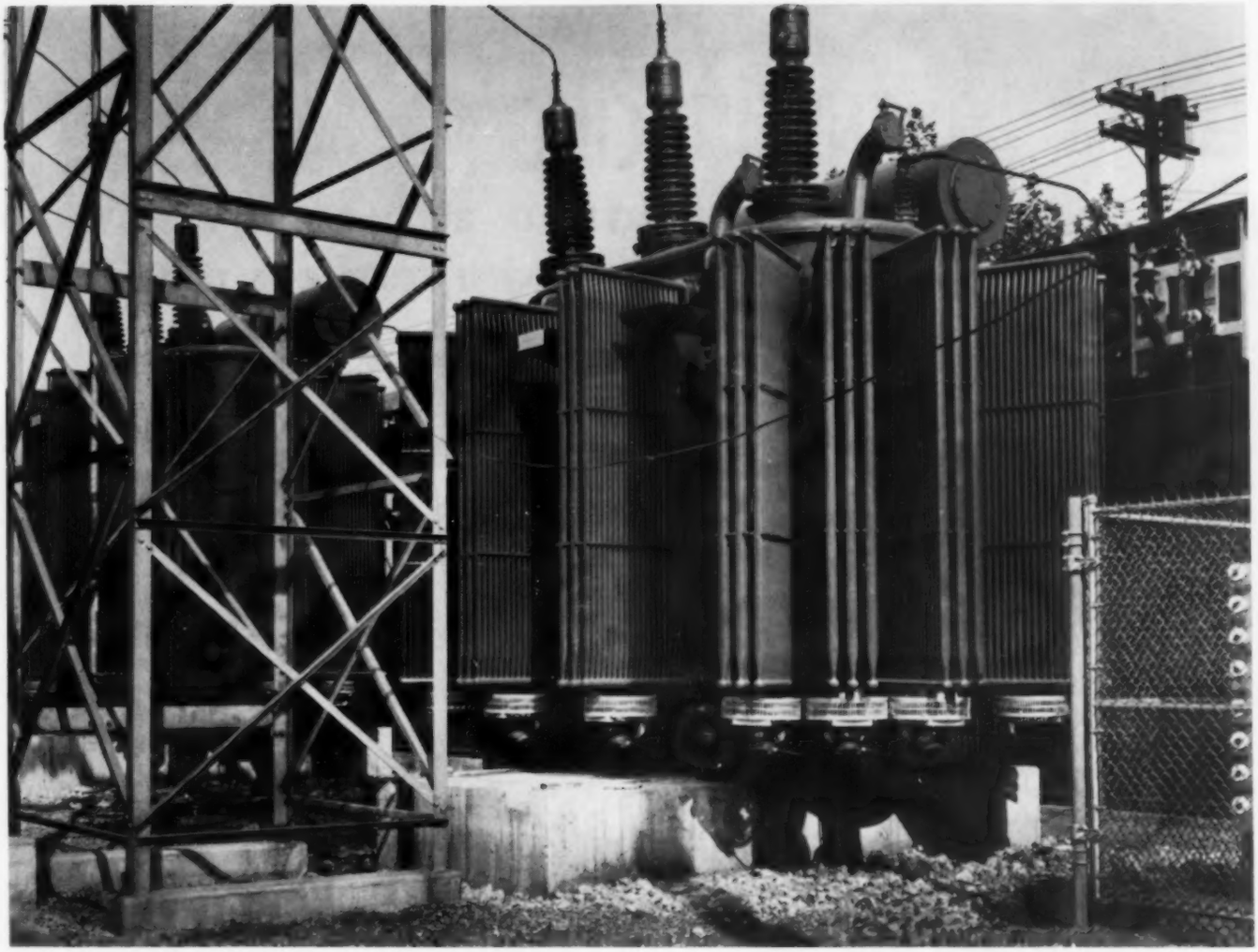
Continuous casting is expected to have outstanding economic benefits, especially in the intermediate and specialty steel fields. Advantages include:

1. Elimination of scrap pieces which result from conventionally cast ingots, except for a short section at the beginning and end of each continuous casting run.
2. Surface and internal quality of the continuous cast billets or slabs are equal to conventionally cast ingot sections.
3. With proper molds for a continuous casting machine, pieces after a quick reheat may be sent directly to the finishing mill if desired.
4. Where blooming mills are available and used for some reduction of billets or slabs from the continuous casting machine, blooming time is decidedly lessened.
5. A full-scale machine such as that at Atlas can be operated by a crew of five or six men.

REHEATING AND BLOOMING

On delivery from the continuous casting machine, slabs still retain considerable heat, which allows rapid reheat to rolling temperatures. Present procedure is to transfer the hot castings directly to the soaking pits or, in the case of tool steels, to forge furnaces. After as little as one hour furnace time, the casting is evenly reheated to the proper temperature for hot working. In the case of stainless steels for strip or sheet production, 5½ in. x 21½ in. castings are rolled on the company's 26-in. blooming mill to 2¼ in. thick x 11 in. to 19 in. wide slabs. These are delivered hot to an automatic powder scarfing unit.

Provision has been made for a "high-head" furnace in line between the casting unit and blooming mill which could reheat the hot castings in a matter of minutes, eliminating the use of the soaking pits entirely for



2 PENNSYLVANIA TRANSFORMERS

supply most of the 60-cycle power to J&L STEEL 's Pittsburgh Works

Supplying the 60-cycle power requirements for Jones & Laughlin's Pittsburgh Works is the primary function of these two 15,000/20,000 Kva Pennsylvania Power Transformers. Eleven of J&L's open hearth furnaces receive their electric power through these transformers. J&L's new blooming mill, No. 10 bar mill, new river pumps, and frequency changers are also served by these transformers. In addition to this installation, two 25-cycle banks of Pennsylvania Power Transformers, located at the Eliza Street Substation, supply the power to J&L's blast furnaces. These and other Pennsylvania transformer installations at Jones & Laughlin Steel Corporation are representative of the power transformers Pennsylvania designs and manufactures for the country's leading industrials and utilities.

Write **for your free copy of Bulletin No. 309 entitled "Design and Construction of Transformers for the Steel Industry."**

PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division • **Box 330 • CANONSBURG, PA.**

ANNOUNCING... DRAVO'S LINE OF LURGI DESIGNED EQUIPMENT FOR TREATING ORE AND CONCENTRATES

Lurgi designed and built 3200 ton per day sintering plant installed at English steel mill

Dravo Corporation now has exclusive license to manufacture and distribute LURGI* designed equipment for sintering, pelletizing and related preparation and processing of iron ores or concentrates.

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LURGI Gesellschaft fur Chemie und Huttenwessen, Frankfort A.M., Germany, is Europe's oldest and foremost designer of ore processing, sintering and pelletizing machines. LURGI Chemie's Down-Draft Sintering Process has gained wide European acceptance since its introduction in 1906. At present, LURGI machines process 90% of the ore sintered in Germany. Yearly output of all LURGI Chemie installations throughout the world, for treating iron ore alone, totals 30 million tons.

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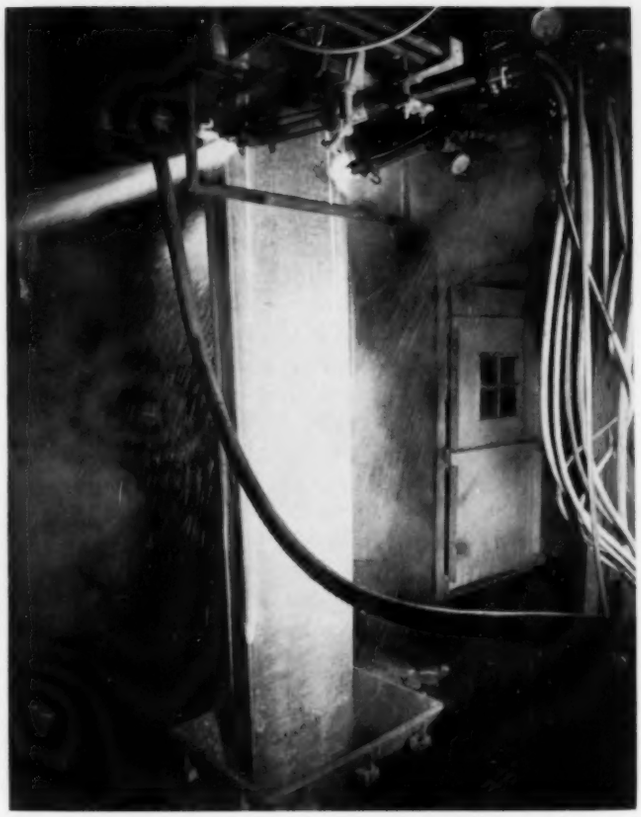


Figure 5 — The twin torches move downward with the casting and cut it into desired lengths. They automatically clamp on the casting, cut and release from the casting in proper time and sequence.

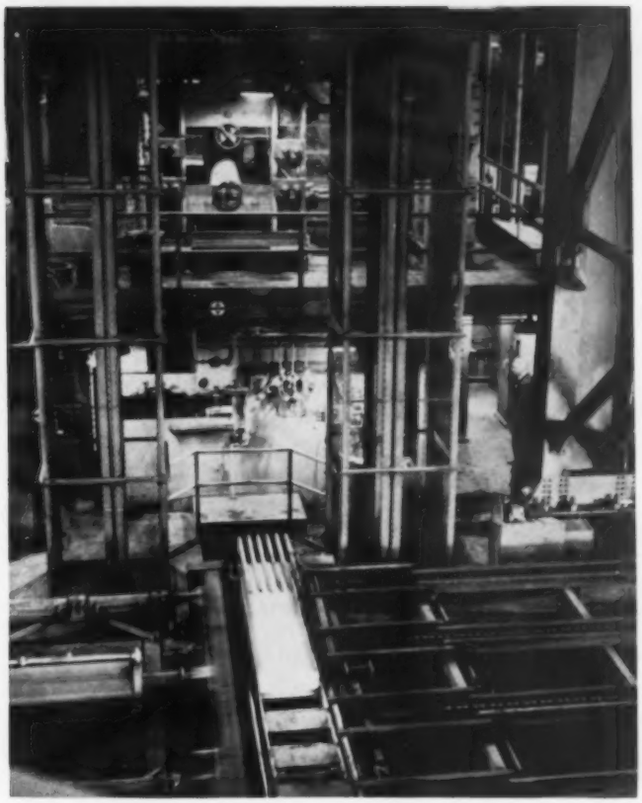


Figure 6 — Front view of ground floor level of continuous casting machine shows carrier emerging from pit with finished slab.

concast materials and allowing the processing of 16-ft castings against the present 8-ft lengths. Experiments are planned to eliminate any intermediate cogging and allow direct rolling of slabs on the planetary mill.

In 1943, a Linde oxy-acetylene hot desurfacing machine was installed for use on steels other than stainless, conditioning the surface of hot slabs and blooms from the blooming mill on all four sides at one time. In order to make this process applicable to stainless steel, considerable experimental work was performed. Powder scarfing had previously proven practical in single burner hand torches. Application of powder scarfing in an automatic machine involved the problems of finding a method of introducing the powdered iron at a satisfactory rate in four different directions, removing the resultant smoke and fumes and the resultant slag, and satisfactorily cooling burner components to prevent deterioration under increased operational temperatures.

After two years of experimentation and three modifications of installations, the machine was capable of performing the desired task. Best results are obtained with a temperature of about 1900 F on the stainless steel slab from the blooming mill, a slab speed through the machine of about 110 fpm, an oxygen pressure of approximately 30 psi, and a flow rate of 5 oz of powdered iron per nozzle per minute under 15 psi air pressure.

Slag resulting from scarfing is removed by a series of high pressure water jets spraying on the slab just behind the cutting flame.

The scarfed slabs, after cooling, are put through a Wheelabrator, in which steel shot is blasted at high speed against all four sides of the slab, removing scale and slag resulting from the scarfing operation. The machine is designed to handle a full range of slab and billet sizes and will take the entire production of the scarfing machine.

After visual inspection, spot grinding of up to 5 per cent of the slab and billet surfaces may be required. The advantages of this combination of conditioning methods can be appreciated when it is considered that present indications show a saving in conditioning time of about one man-hour per ton.

After conditioning, billets and slabs are delivered to the finishing units for production of bar, wire, forgings, sheet, light plate and strip.

STRIP AND TUBE MILL

The new strip and tube mill was laid out to produce 500 tons of cold finish strip and 130,000 ft of tubing per month. Hot rolled strip is shipped in gages from 0.062 in. to 0.187 in. and any width up to 18 in. can be furnished annealed with edge as rolled or slit. Space was provided for future installations of processing equipment to double this output.

Buildings and equipment are arranged to receive slabs from the conditioning line at the north end of the new hot mill building, and ship strip and tubes from the north end of the cold mill building. Thus the material flows in the form of a "U." The buildings themselves cover a total area of 123,625 sq ft, the hot mill building being 1200 ft long x 45 ft wide. The connecting building housing control and motor drive equipment is 625 ft long x 25 ft wide. The cold mill building is 700 ft long x 70 ft wide.

The hot strip mill is capable of handling slabs 2¼ in. to 3 in. thick up

to 20 in. wide by 8 to 32 ft long. Products are 0.062 in. to 0.187 in. thick strip and sheet bar up to 1 in. thick. Sheet bar will be produced for the hand sheet mills, thus reducing the breakdown rolling required and increasing the efficiency and capacity of sheet producing units.

The slab depiler is designed to receive a pile of slabs up to 21 in. high, 8 ft to 32 ft long, with a maximum weight of 43,000 lb. Slabs are peeled off individually into the pinch rolls by a pusher which travels at 42.5 fpm. When the front end of the slabs strikes a flag switch on the delivery side of the pinch rolls, the top feed roll lowers and delivers the slab onto the furnace entry table at a speed of 25 fpm. As the back end of one slab passes an electric eye which may be set for various slab thicknesses, the depiler table automatically raises the entire pile the thickness of one slab so that it in turn can be pushed off onto the delivery line. Thus, the depiler provides a continuous flow of conditioned slabs with a minimum expenditure of manpower.

The slab passes over a 42 ft table to the slab heating furnace, which was designed and built by R. S. Products to heat a maximum of 25 tons per hour, continuously, of 2¼ in. x 20 in. stainless steel slabs to a temperature of 2250 F at a speed of 7 fpm. The furnace has a total of 80 burners, with four burners in each of 20 chambers which are divided into five control zones. Forty burners fired into the heating chambers on one side above the work level and forty on the opposite side below the work level. This creates a cyclonic heat flow around the slab and the waste products of combustion are vented through flues between chambers to the roof. The roller hearths which convey the slabs through the furnace consist of two sections with twelve rollers in each section. The rolls are 7 in. in diameter, each driven separately at varying speeds from 0 to 11.5 fpm ahead, and 0 to 29.2 fpm in reverse. The rollers are made of heat resisting alloy mounted in water-cooled anti-friction bearings. Three sets of hydraulically operated water-cooled side guides mounted in zones 4 and 5 and at the furnace exit are used to center the slab before it leaves the furnace.

The overall outside dimensions of the furnace are 74 ft 6 in. long x 7 ft 11½ in. wide x 7 ft 4¼ in. high. It is fired with No. 3 fuel oil and develops 13,000,000 Btu per hour maximum. The maximum operating temperature is 2600 F; fuel consumption is approximately 500 imperial gallons per hour.

The planetary hot mill and its method for rolling strip are radical departures from the conventional. As planetary rolls will not feed themselves, two sets of feed rolls are mounted in the same housing immediately preceding the planetary rolls. Each pair of feed rolls is driven by a 35-hp mill type motor. Their purpose is to supply a power feed by taking $\frac{5}{32}$ in. reduction in each set to push the slab through the planetary rolls. The feed rolls are 17¾ in. in diameter x 28 in. face, and have a normal speed range from 0 to 8.8 fpm. The first set can be speeded up to 17.6 fpm to close any gap between slabs.

The work of reduction is carried out by 48 small diameter work rolls equally spaced around the circumferences of two heavy back-up rolls which are driven by a 1250-hp motor. The work rolls are 3⅝ in. in diameter x 24⅛ in. face; the back-up rolls are 27 in. in diameter x 24 in. face. The back-up rolls are driven in the direction of strip travel at 297.5 rpm. The work roll chucks are mounted in cages which in turn are mounted on the back-up roll necks and rotate in the same direction as the back-up rolls. The whole assembly resembles a roller bearing without an outer race. The chucks are held in place in the cage by springs which hold the work rolls firmly against the circumference of the back-up rolls. The work rolls thus rotate in the opposite direction to the back-up rolls, i.e., opposite to the direction of the strip travel. All four cages are linked together with synchronizing shafts and geared so that the work rolls around the top back-up roll match the work roll around the bottom back-up roll; that is, as the cages rotate, the work rolls will always come together in step and strike the entry end of the slab simultaneously.

Before the slab enters the planetary rolls, the cage assemblies are driven through a double acting air clutch from the planetary mill drive at a speed of 146 rpm. At this cage speed, the work rolls are driven by

Figure 7 — Discharge end of the high-head furnace (extreme left), the planetary mill (directly in front), the 2-high finishing mill (left), and part of mill run-out table are shown here.

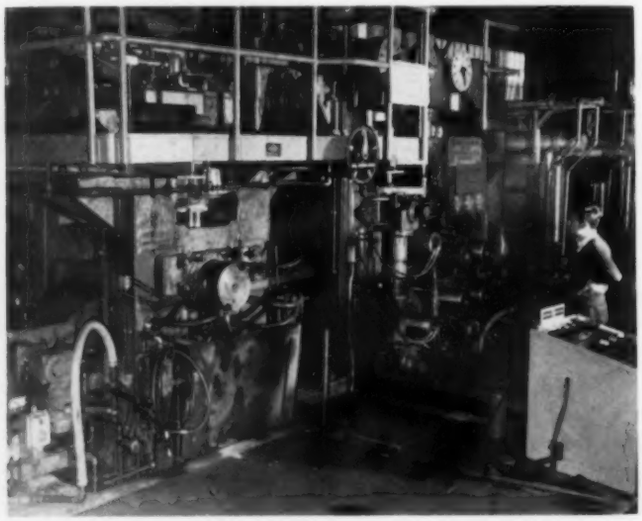
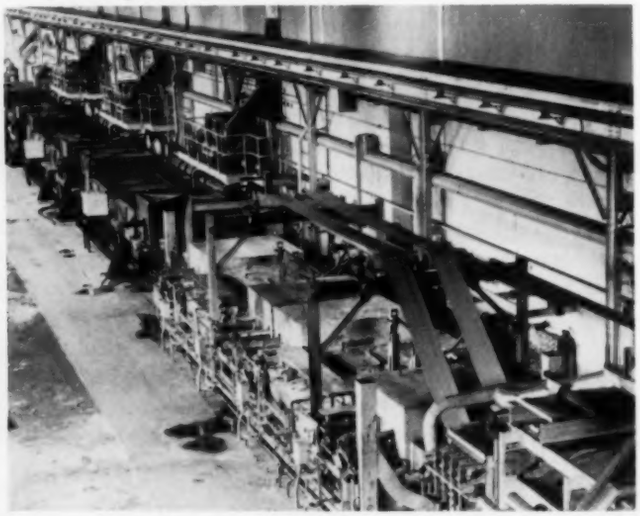


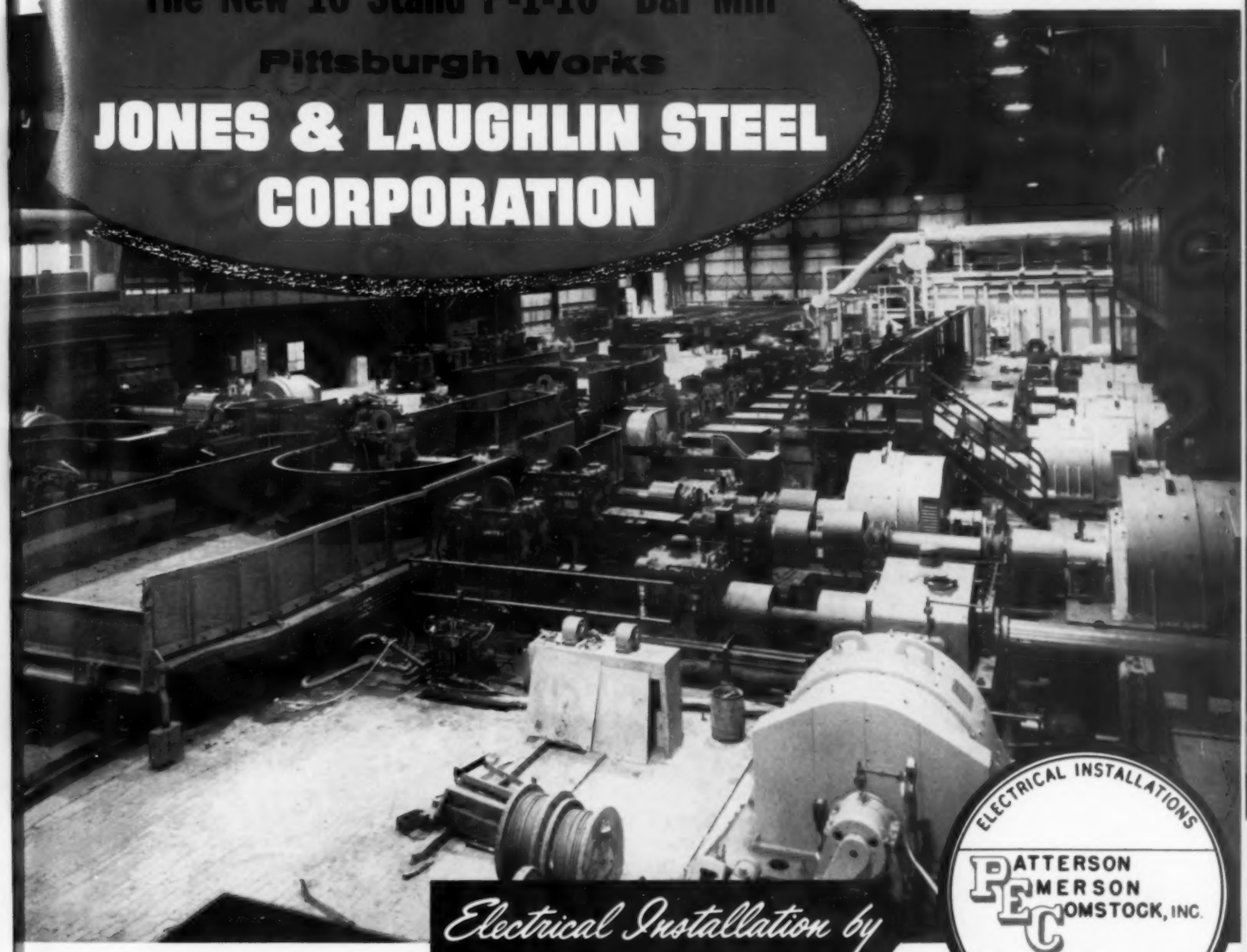
Figure 8 — To illustrate the versatility of the anneal and pickle line at Atlas, cold rolled strip is shown leaving the catenary furnace by-passing the twin in-line salt descale units and going into three following pickling tanks.



The New 16 Stand P-1-10" Bar Mill

Pittsburgh Works

JONES & LAUGHLIN STEEL CORPORATION



Electrical Installation by

ELECTRICAL INSTALLATIONS
PATTERSON EMERSON COMSTOCK, INC.
PEC
PITTSBURGH, PA.

Electrical Equipment Required for Operation of this Mill Includes:

12 Roll Drive motors

18 Motor Generator Sets in the main and auxiliary power, control and excitation systems

332 Auxiliary Drive motors

2 Load centers for AC and DC low voltage power supply

Combined rating of electrical equipment connected totals: 38,685 HP, 18,000 ft., feeder cables in the power circuits.

Since its organization in 1946 PEC has completed, or has under construction, 150 major projects with electrical equipment consisting of more than:

1,596,000 KW in Power Generators

4,346,380 KVA in Line Transformers

3,230,290 HP in Industrial Equipment with total billing cost exceeding:

$90,000,000

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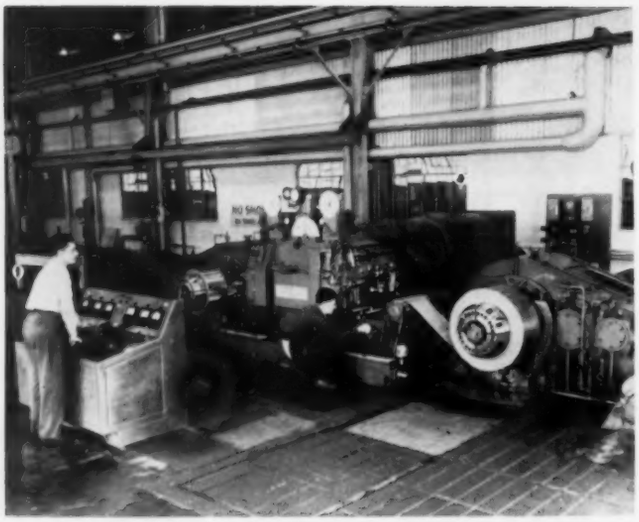


Figure 9 — One operator and helper cold roll annealed strip on Sendzimir cold mill. Rolling is done under oil bath. Work rolls in the mill are only 1⅝-in. in diameter.

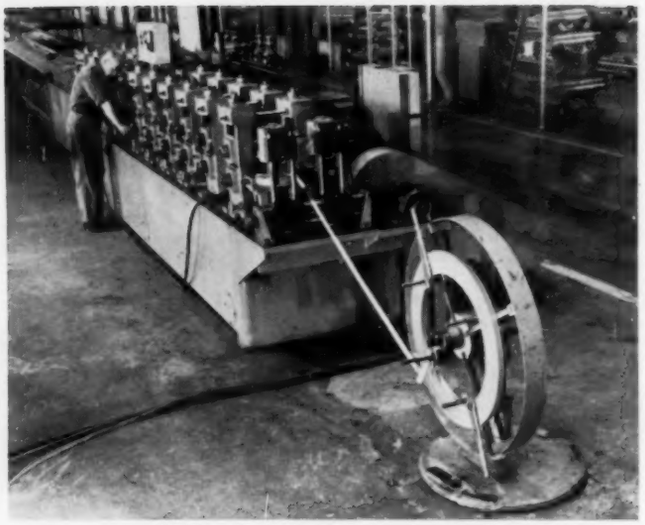


Figure 10 — Welded stainless tubing is processed on this welder former. It is cold formed to shape and automatically welded under helium. No filler rod is used. This mill produces tubing up to 2-in. in diameter.

the back-up rolls at a speed of 1130 rpm. The clutch is disengaged immediately after the slab enters the planetary rolls and the cages find their proper speed for rolling. The heavy reduction on the slab made by the planetary rolls increases the metal speed during the roll bite from the typical entry speed of 6 fpm to a strip speed of 100 fpm, more or less. The planetary mill makes a reduction on a slab of approximately 95 per cent in one single pass.

As the strip leaves the planetary rolls, it passes to a two-high finishing mill. The rolls of this mill are 22½ in. in diameter x 30 in. face, and are driven by a 250-hp mill type motor. A looper-roll is mounted on the entry side of this mill to control strip tension between the planetary mill and the finisher, and also for speed control of the finishing mill. The distance between the center line of the planetary and finishing roll is 9 ft 6 in.

The strip then passes over the mill run-out table to the coiler. This table is 78 ft long and has a speed of 288 fpm.

The coiler is a conventional three-roll upcoiler with pinch rolls. It is driven by a 35-hp mill type motor at variable speeds to suit strip travel from the mill.

FINISHING EQUIPMENT

Following hot rolling and coiling, normal procedure is to level and edge trim the hot band, and then anneal and pickle it for subsequent cold rolling or delivery as No. 1 finish hot band product.

The hot rolled trimming and slitting unit is composed of an uncoiler, a roller leveler, a hydraulic up-cut shear, a vacuum blast to clean strip ends, a slitter and scrap cropper, and a recoiler and overarm separator device.

This line operates at a speed of 75 to 300 fpm on individual coils. All processing lines are equipped with 22-in. diameter reels and handle coils 44 in. maximum outside diameter, 5000 lb maximum weight.

The annealing and pickling line is designed to process and clean all grades of stainless strip in hot or cold rolled condition. Two strands of strip 0.007 in. to 0.187 in. thick x 10 in. to 20 in. wide are processed simultaneously at speeds of 5 to 50 fpm. Each strand is controlled through the line independently. In actual practice, all strip proceeds through this line in a continuous form, with the end of one coil being spot welded to the end of the following coil to form a continuous strip. It then passes through the looping pit which allows the time cycle for spot welding without interruption of flow through the balance of the line.

The strip is then fed to a catenary annealing furnace 40 ft long x 7 ft wide x 6 ft 8⅜ in. high, inside. The furnace has three controlled zones and burns anthracite producer gas of 142 Btu per cu ft, with an hourly consumption of approximately 80,000 cu ft. Temperature is automatically controlled.

After leaving the annealing furnace, steel can be quenched by a combination steam-air or water vapor. It then travels into two Kolene salt tanks in series. Believed to be the first of its kind in operation anywhere, the salt descaling unit replaces mechanical scale breaking equipment used elsewhere.

This unit descales hot rolled strip by means of molten sodium hydroxide plus electrolytic action, and descales cold rolled strip by means of the molten salt alone. The salt is maintained at a temperature of 900 F by gas burners. Tanks are insulated from each other, and in the No. 1 salt pot, the electric grids are negative, while in the No. 2 salt pot, the grids are positive. Thus in No. 1 tank the strip is positive, while in No. 2 tank the strip is negative. Because the tanks are insulated from one another, the current must follow through the strip. In the first tank, the scale on the strip is oxidized and in tank No. 2, the oxidized scale is dissolved. By using this method of scale breaking and a subsequent pickling in one or more of the following three pickling tanks, any desired type of pickle finish is obtained.

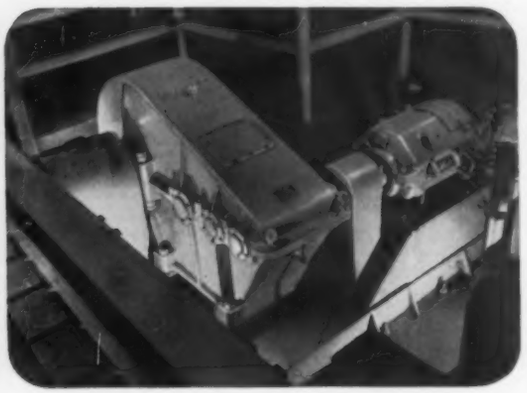
The acid tanks in line consist of a hot sulphuric acid tank, an electrolytic sulphuric acid tank, and a hot nitric-hydrofluoric acid tank.

Leaving the acid tanks, the strip passes through a scrubber-dryer and an inspection station. After inspection, the strip passes through master pinch rolls, which provide motivating force throughout the entire line and

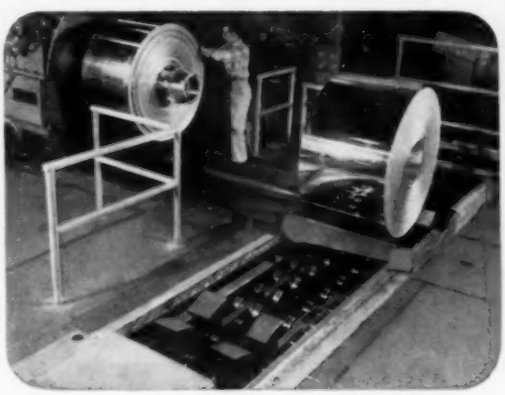
How LINK-BELT serves J & L

AT PITTSBURGH

This double-strand Link-Belt coil conveyor, one of two at Pittsburgh works, easily handles coils weighing up to 60,000 pounds.

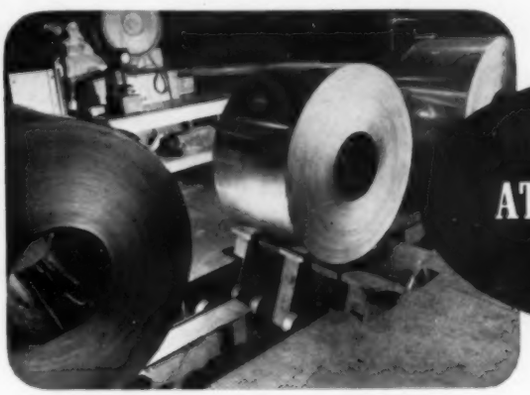


Parallel shaft drive provides efficient speed reduction. Jones & Laughlin relies on Link-Belt equipment throughout their mills.



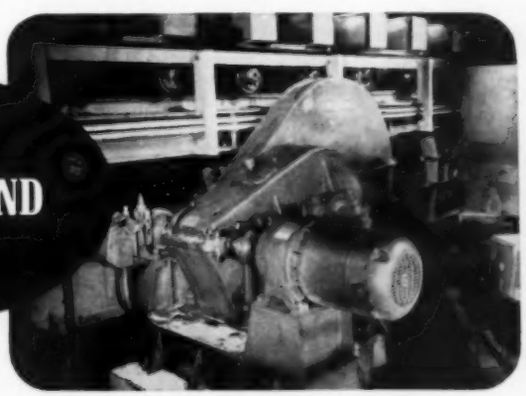
At entry to shear line, up to 72-in. coils are lifted from Link-Belt saddle-top conveyor to pay-off reel by hydraulic buggy.

AT ALIQUIPPA



Precise weights of up to 40,000-lb. coils are recorded as they move along Link-Belt conveyor at temper mill delivery end.

AT CLEVELAND



Booster drive at J & L's Cleveland works includes Link-Belt Electrofluid, parallel shaft gear and precision steel roller chain drives.

Yield goes up, waste goes down on the 77-in. hot strip mill served by Link-Belt car-type conveyor. Coils are moved gently, safely.

LIKE so many other leading steel mills, Jones & Laughlin has used Link-Belt conveying and power transmission machinery for many years. In addition to handling coils, Link-Belt conveyors assure economical movement of materials in every step of steel making, from raw materials to finished product. Next time you're in the market for a single conveyor or a complete system—call the Link-Belt office near you. We're sure you'll like the expert engineering cooperation promptly available to you.

LINK-BELT

MATERIALS HANDLING, PROCESSING & POWER TRANSMISSION EQUIPMENT

13,886

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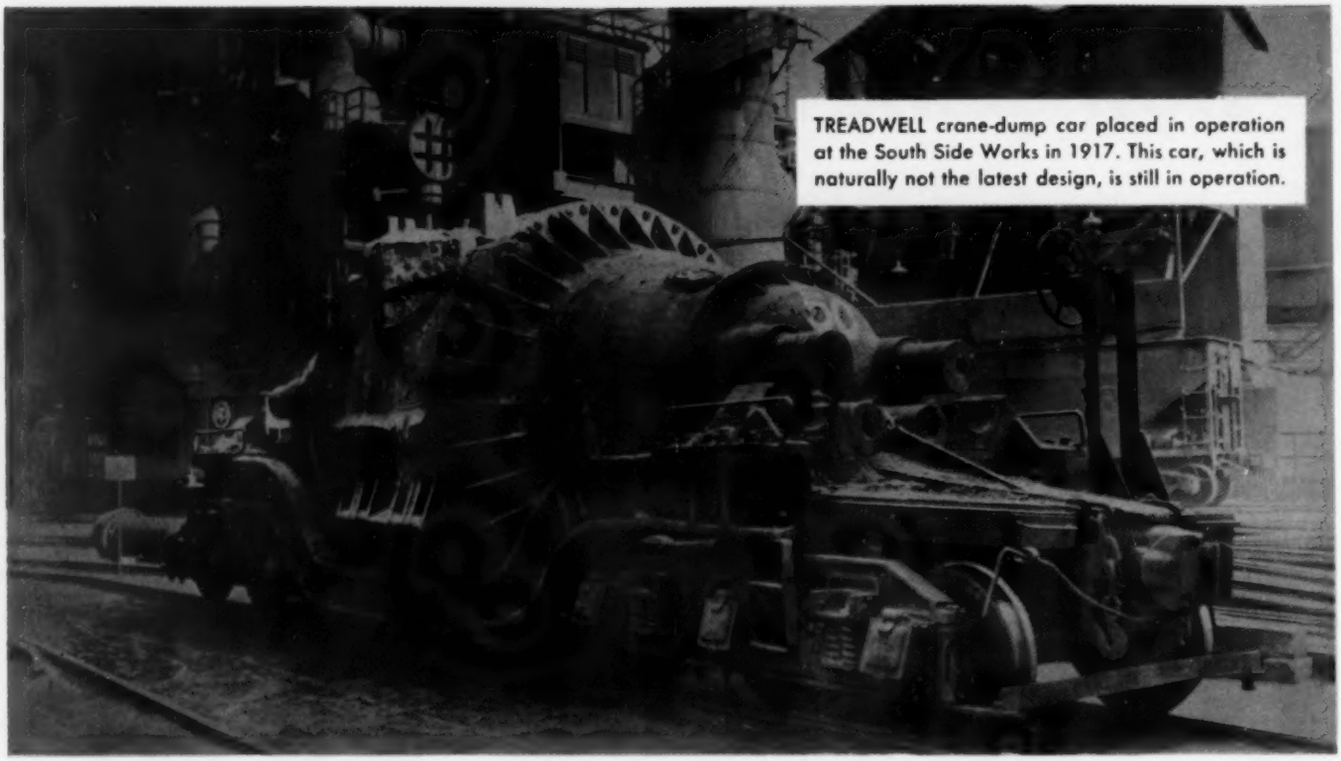

TREADWELL crane-dump car placed in operation at the South Side Works in 1917. This car, which is naturally not the latest design, is still in operation.

How 23 mixer cars paid for themselves in one year at J & L's South Side Works

Jones and Laughlin's twenty-three TREADWELL Mixer-type Hot Metal Cars, paid for themselves in savings in iron that would have been lost as ladle skulls in open-top cars.

Practically all users claim no ladle skulls are formed in TREADWELL Mixer Cars. Reports indicate varying amounts of ladle skulls with open-top ladles—a conservative figure would be 3% of the total iron handled.

Assume it is only 1%. This is a daily loss of pig iron production of 14 tons on a furnace of 1400 tons capacity, or about 5000 tons per year. That production can never be recovered. Further, breaking up the skulls from an open top ladle, transporting to the blast furnace and recharging probably costs several dollars per ton.

Should skulls form in a mixer car under abnormal conditions—such as cold iron, off-iron or interruption of operations requiring the iron to be held in the car far in excess of ordinary procedure—the skulls do not have to be removed from the ladle. They will be quickly melted by subsequent casts of iron.

This saving in iron is only one of the many advantages of TREADWELL'S exclusive Mixer-type Hot Metal Car. Send for a copy of the *new* bulletin No. 60 which describes these cars in detail.

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TR-8

TREADWELL

Mixer-type
HOT METAL CARS

into a double acting down-cut shear which shears out the lapped, spot welded joints. The strip is then run over a belt conveyor and onto recoilers, where it may be coiled with or without protective paper inserts. At this particular point tests for hardness and other laboratory examinations are cut and identified as to individual coils.

On leaving the anneal and pickle line, the coil is ready for cold rolling, which is done on a reversing Sendzimir mill. In regular operation, coils of annealed and pickled stock are delivered to the cold mill by lift truck. From the uncoiler, the band passes through a roller leveling unit, over tension rolls, through the mill to an exit tension reel, where the front coil end is gripped. The work rolls are brought together and strip is reduced as it is coiled on the exit reel. The coil is rolled back and forth in either direction under controlled tension. The number of passes and the draft depend on the desired strip thickness and grade of alloy to be rolled. During rolling operations, paper may be wound or unwound automatically in and out of the coil on either side of the mill to prevent rubbing and scoring of coil surface.

Electrolimit gages give the roller accurate thickness measurements to 0.0001 in. at all times. The work rolls of this unit are $1\frac{9}{16}$ in. in diameter. Back-up rolls are nested in such a way as to allow little or no deflection of the work rolls; thus the strip product is remarkably free of crown. An interesting feature of this process is that both the strip and work rolls are completely immersed in an oil bath at all times during rolling.

The mill is driven by a 300-hp, 600/1000-rpm motor, while reel motors are 200-hp, 300/1200 rpm, moving the strip through at speeds up to 500 fpm.

The strip can be reduced in a required number of passes by as much as 90 per cent in thickness. Each pass hardens the steel. If a very thin gage is required, the coil may be returned for intermediate annealing and pickling. The small work rolls of the Sendzimir mill reduce the pressure necessary to reduce the strip, since only a small area is under working pressure. This gives a short roll bite, minimizing heat generated.

Skin passing is performed in a Treadwell mill consisting of a feed reel with hydraulically operated coil buggy for loading and unloading coils, a two-high stand with rolls $18\frac{1}{2}$ in. in diameter x 24 in. long, driven by a combination pinion and gear drive, and a delivery reel with hydraulically operated coil buggy.

The coil is positioned on the feed reel by the coil buggy. The operator jogs the feed reel forward, feeding strip to the mill rolls. A hold down roll keeps the coil from unwinding during threading operations. As the head of the strip enters the rolls between adjustable side guides, both the feed reel and the rolls are jogged forward, moving the strip head to the delivery or winder reel. A hydraulically operated gripper mechanism holds the strip head while the operator jogs the winder reel forward until the steel is securely wrapped around the winder mandrel. Tension is then applied to both the entry and delivery ends of the strip. The mill and reels are then started and brought to a preset thread speed which may be up to 75 fpm. This allows the operator to make any final adjustments before switching over to preset line speed, which may be up to 600 fpm. When the mill has drawn almost all the strip from the feed reel, the operator switches back to thread speed and the rest of the coil is wound on the delivery reel. A stripping mechanism strips the coil from the winder mandrel and the operation is completed.

This mill is used to flatten or stiffen strip for special applications and to eliminate the hazard of stretcher strains in the type 400 series strip when press-formed in a fabricator's plant. Paper is wound between the layers of strip on the coil at the delivery reel end to protect the strip finish.

Reels are individually driven by 100-hp motors, while the rolls receive their power from a 150-hp motor.

Coils processed by this mill move on to a side trimming and slitting line, where the strip is cut into exact widths to customer requirements or slit to close tolerance for tube making. This line consists of an uncoiler, a slitter, a scrap baler, a recoiler with overarm separating device, and a turnstile unloader.

The line operates at speeds up to 300 fpm and is capable of handling cold rolled strip 0.007 in. to 0.083 in. maximum thickness and up to 20 in. wide.

Should the material strip be required in lengths rather than coils, the coils are taken to a leveling and shearing line which can make up to 18 cuts per minute on stainless strip 0.010 in. to 0.150 in. thick, 20 in. wide, cutting lengths of 2 to 10 ft.

TUBE DEPARTMENT

Strip for welded stainless tubing comes to the tube department in coils from the cold slitting line.

A coil is positioned on the uncoiler, and threaded through the tube mill, which consists of six horizontal forming stands, four vertical forming stands, and one set of vertical welding rolls. These stands center the strip and progressively form it until its edges meet. This rough tube enters a seam guide and is then jogged into wilding pressure rolls which close the seam prior to welding. Then an automatic electric arc welding machine joins the edges under a blanket of helium. No filler rod is used. The welded tube then passes through a water spray, then on into the three horizontal and two vertical sizing stands which make the walls of the tube form a perfect circle. A flying cut-off saw unit cuts the tube automatically to desired lengths.

Tubes $\frac{1}{2}$ in. and under are then immersed in a water bath with air test adaptors clamped to both ends. They are tested at 250 psi. After this test the tubes are degreased in a solution of trichloroethylene, then taken to the bright anneal furnace.

The bright anneal furnace brings the tubes to the desired annealing temperature, depending on grade and customer's specifications. This is done in an atmosphere of cracked ammonia to prevent the formation of scale and to retain the bright finish of the cold drawn tube in the final product. To accomplish this, tubes are conveyed by continuous strip belts into gas-filled muffle tubes. The rate of travel for the tubes through the bright anneal furnace and cooling zone depends on tube wall thickness and the customer's specifications.

After bright annealing, tubes are pointed by swaging machines in preparation for their first draw through a series of progressively smaller dies until the desired size is achieved. This is done at the draw bench with an alloy mandrel bar inside the tube. Both are drawn through the die, in-

creasing the length of the tube, reducing the diameter and removing the weld ridge. Between draws, tubes are degreased and bright annealed.

Finally, tubes are straightened by passing through two sets of feed rolls and two bending rolls. Tubes emerge from this unit perfectly true and are then cut to desired lengths. Air or hydro testing follows according to specifications, before shipment.

All tubes 1¼ in. and over in outside diameter are annealed in the 85-in. annealing furnace and then pickled in the cold draw department. With this exception, procedure is the same as with the smaller tubes.

In addition to the aforementioned major items of new production equipment, Atlas has also installed other important units to round out and improve its manufacturing operations. Over and above normal research and development requirements, the company has encountered an increasing customer demand, particularly in the aircraft industry, for small quantities of special analysis steels. This trend indicated the need of additional melting capacity which would economically produce experimental grades in quantities of less than 1000 lb. Consequently, induction melting facilities have been installed, including one 750-lb melting furnace, one 350-lb vacuum furnace, and one 100-lb furnace for melting and casting in vacuum. A 175/200-kva high frequency generator, driven by a 275-hp synchronous motor, supplies power for these melting units.

To provide fast accurate chemistry checks of steel during melting, a spectrometer has been installed in the company's chemistry laboratories adjacent to the melt shop. This device reduces furnace time during melting by providing chemistry checks in approximately 10 minutes against standard times of 15 minutes to one hour when normal wet chemistry techniques are employed.

Plate Heat Treating Line to be Installed at Lukens Steel

▲ THE Drever Co. of Philadelphia has recently received an order for a plate heat treating line for hardening, tempering and normalizing plate to be installed at the Lukens Steel Co. as part of the present expansion program. This will be the largest continuous plate heat treating line in the world and will handle plates up to 172 in. wide x 3 in. thick x 480 in. long. To house this line, a new building is being erected and to obtain the necessary water supply for the quench, etc., a nearby stream is being diverted and a reservoir of 5,000,000 gallons capacity built.

The facilities consist of a 52-ft long charging transfer car, 145-ft long hardening roller-hearth furnace, 10-ft long transfer table, 45-ft long 2500-ton pressure quench, 52-ft long transfer car, 200-ft long by-pass conveyor table, 52-ft long transfer car, and 200-ft long tempering roller-hearth furnace. Additional facilities include a wider 200-ft long conveyor table and 52-ft long transfer car to serve the customer's 200-in. roller leveler and an additional by-pass conveyor for the 200-ft furnace. All conveyor rolls, furnace doors and transfer cars will be motor-operated and controlled by one man from a control house located adjacent to the quench press.

The temperature range of this line will be 750 to 1650 F and heat treating cycles will be variable to accommodate the wide variety of plates for which the line is intended. Rated capacity is 9 tons per hour of net size plate and maximum capacity is 19.2 tons per hour net plate.

Special provision is being made for quick roll removal and replacement in design of the furnace casing and roll drive.

The 200-ft furnace is designed for reversible heating so that, when normalizing plate, the furnace may be charged from either end. When processing armor plate, it will be used in one direction only towards the quench press end.

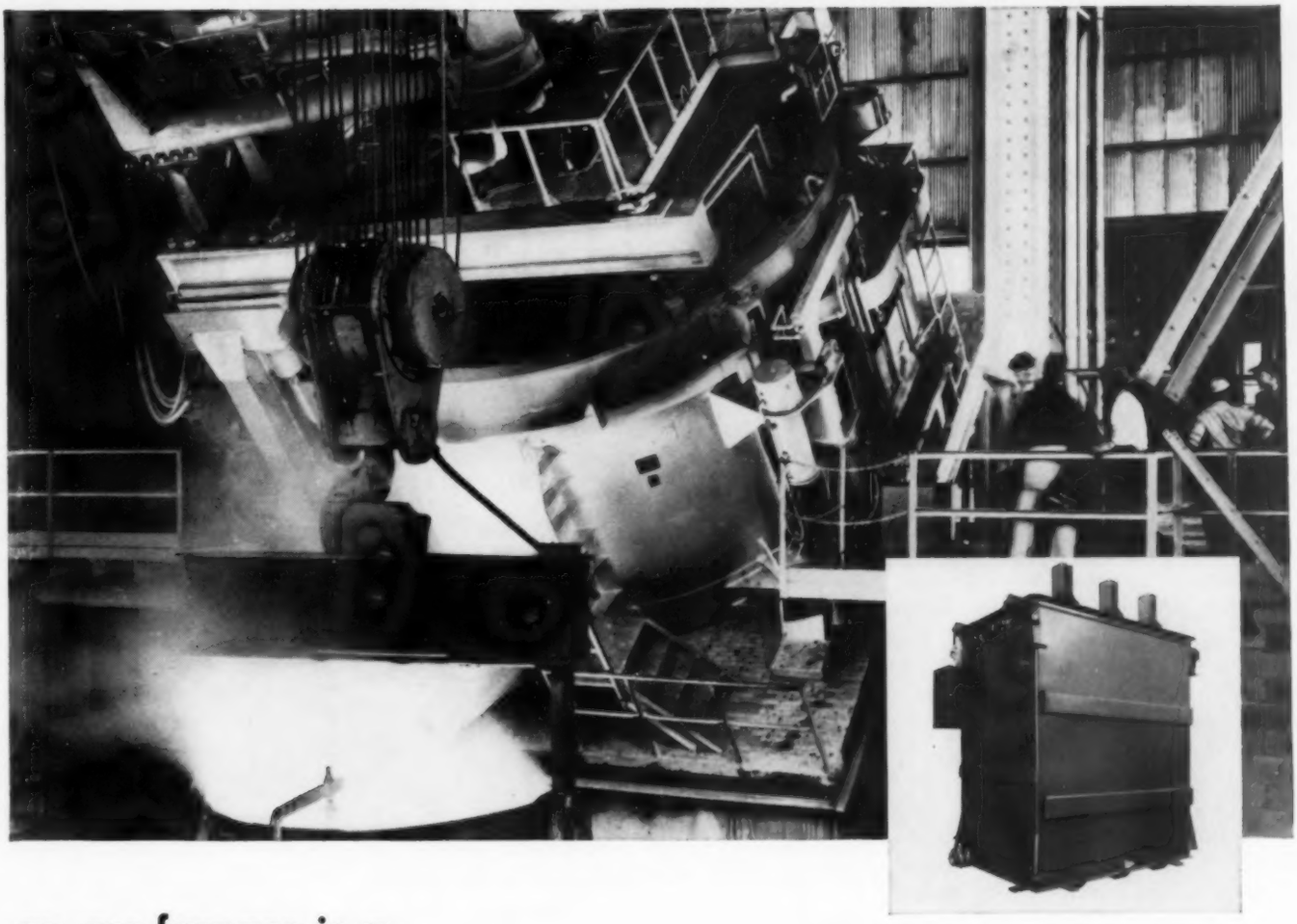
The furnaces will be direct-fired with combination natural gas or oil-tempered flame burners. Control-panels will be located in a control room adjacent to the operator's room. Over-temperature protection will also be provided to prevent furnace rolls from exceeding the top furnace temperature. The maximum connected fuel capacity for both furnaces will be 121,000 cfh of natural gas or 860 gph of light fuel oil.

The pressure quench will have an effective bed, 15-ft wide x 43 ft long and a maximum pressure of 2500 tons. Quench water will be directed on the work by means of renewable spray pipes built into the upper and lower platens, fed by manifolds. Water control will be in six sections by means of air operated diaphragm control valve, push button operated from the control room. Maximum water consumption will be 24,000 gpm at 45 to 60 psi and furnished by three 400-hp, 8000-gpm pumps.

An electrical control center located below the operator's control room will contain all motor starters, the main circuit breaker and transformers for reducing line voltage for control power.

Besides inter-phone communication between various parts of the line and/or the control room, two television receivers in the control room with five cameras placed strategically around the facilities are contemplated to give the operator full knowledge and vision of the work throughout the heat treating cycle.

Completion of this installation is scheduled for early spring of 1955. This line is in addition to the stainless plate heat treating line now being installed for the same customer which is scheduled for completion this fall.



an arc furnace is a

TOUGH LOAD FOR ANY TRANSFORMER

Why you should depend upon General Electric equipment for one of electricity's toughest jobs

An arc furnace is a tough load for any power transformer. Sputtering arcs cause frequent heavy current surges—hundreds of times the number encountered in most applications. These repeated surges set up unusual stresses inside the furnace transformer. Unless the transformer is designed to withstand this type of service, expensive failures may occur . . . which can mean the difference for you between a profitable operation and an unprofitable one.

Working with all leading builders of arc furnaces, General Electric engineers have developed transformers designed to take this constant beating. The result is a furnace transformer destined for long life and low maintenance.

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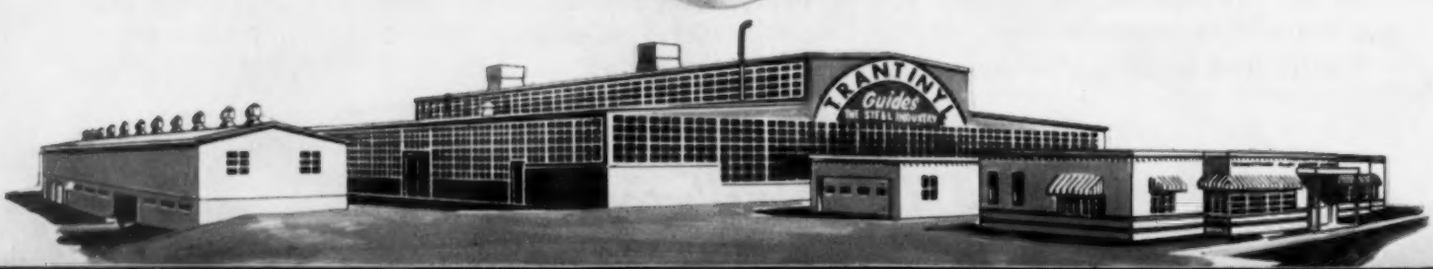

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Rod Coil Handling at Continental Steel Co.

By WALTER BOEHM, Design Engineer, Jervis B. Webb Co., Detroit, Mich.

▲THIS rod coil handling system at Continental Steel Co., Kokomo, Ind. handles the coils from the reels to storage and shipping. The main components of the conveyor system are:

1. Drag conveyor approximately 240 ft 0 in. long.
2. Coil transfer between drag and hook conveyor.
3. Hook conveyor approximately 1400 ft 0 in. long, of which about 900 ft 0 in. is loaded and 500 ft 0 in. is return run.
4. Automatic coil unloader.

DRAG CONVEYOR

The drag conveyor is made in three sections, all driven by one drive at the head end.

Figure 1 — Double-strand and single-strand chain conveyor convey hot coils of rod to takeoff point beyond wall in background where they are transferred to trolley conveyor.

The first section is a double-strand drag conveyor about 135 ft 0 in. long having shark fin type dogs on 6 ft 0 in. centers, which push the hot coils on cast iron bed plates.

The second section is a single-strand drag conveyor about 75 ft 0 in. long with similar dogs on 6 ft 0 in. centers. The double-strand head end overlaps the single-strand tail end to facilitate coil transfer from one section to the other. The second section pulls the coils with the dog engaging the inside diameter of the coil. By changing from double pusher dogs to single drag dogs, deformation of the hot coils, while on drag conveyor, is held to a minimum. Smooth coil transfer is obtained by using conveyor sprockets mounted on adjustable hubs to get proper relation between double and single dogs. Coil marking is eliminated by proper chain track design at transfer point, so that dogs do not engage coils when going over sprockets.

The third section is a double-strand drag about 30 ft 0 in. long with dogs on 6 ft 0 in. centers.

The average speed of the entire drag conveyor line is 18 fpm handling 630-lb coils, one every 20 seconds.

The chain used is forged steel heat treated rivetless type number 9118 which allows quick replacement of links or pins. The chain pitch is 9 in. The weight of the chain is only slightly more than half the weight of an equivalent block link type chain with the same ultimate strength, which results in much less dead weight being moved; in this particular case the dead load moved is about 60 per cent of the live load, whereas with block link chain it would be greater than the live load, which means that at least 25 per cent more power would be required at the drive.

Figure 2 — Coils are transferred from chain conveyor to trolley conveyor in the elevated room shown. The coils in the foreground have been through the cooling zone and are on their way to unloading point several hundred feet to the left.

The drag conveyor receives coil from either 6-laying reels or 3-pouring reels with provisions for 3 additional pouring reels.

The laying reels are located at the tail section of the first drag conveyor section with a high speed slat conveyor as transfer between reels and drag conveyor.

This slat conveyor has a maximum speed of 240 fpm and receives coils by electrical powered rack and pinion pusher from any of the six laying reels and operates parallel with the drag conveyor. As soon as one coil is pushed onto this conveyor, it starts conveying the coil to the head end where the conveyor stops. A pusher transfers the coils onto the drag conveyor.

This operation is entirely automatic and proper electrical interlocks prevent operation of pusher unless drag conveyor dogs allow clearance for coil to pass. The pouring reels are located about 135 ft 0 in. up on the drag conveyor. The coils are pushed from the reels onto a holding table which is located between the reels and the conveyor.

Pushers move coils from holding table onto conveyor at proper time when position of dogs do not interfere.

Figure 3 — Water quenched section of double-strand chain conveyor is just beyond the coilers.

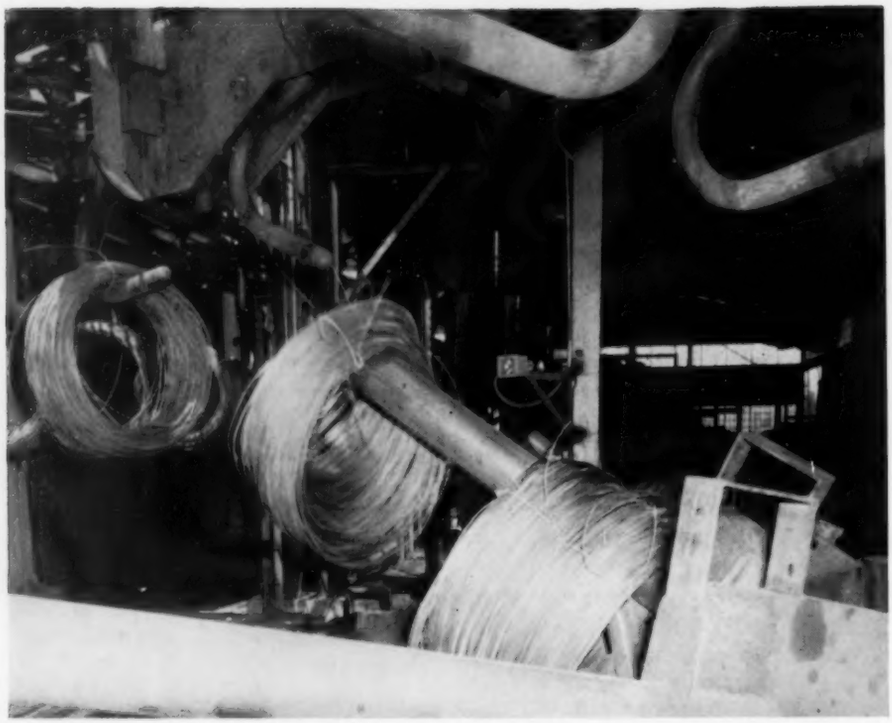


Figure 4 — Coils are automatically unloaded from trolley conveyor to unloading device which accommodates five coils on each arm, then automatically revolves to the next open arm.

The entire drag conveyor line has a total rise of about 20 ft 0 in.

COIL TRANSFER BETWEEN DRAG AND HOOK CONVEYOR

This transfer consists of a heavy pivoted bobber actuated by an adjustable cam mounted on drag conveyor head shaft. At the proper time the bobber, which is mounted between the chains, lifts the back of the coil, and as soon as conveyor hook has entered, the bobber will drop for the next coil.

This transfer is entirely automatic, and smooth leaving the coil in its original form.

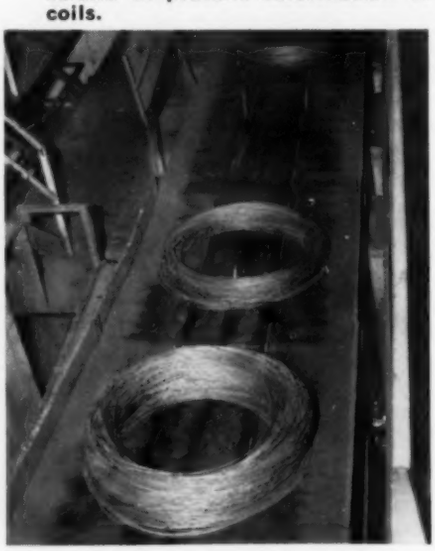
HOOK CONVEYOR

The hook conveyor is a conventional overhead conveyor using a 6 in. pitch rivetless heat treated chain and ball bearing trolley wheels running on 6-in. I-beam track. The hooks are suspended from two trolleys by a load bar, and are equipped with camming rollers which tilt the hook at the unloading station. The conveyor is powered by two floating caterpillar drives and synchronized with the drag conveyor by a mechanical tie, which consists of a caterpillar chain engaging the hook conveyor chain, proper gear ratio, vertical shaft and coupling for connection to drag conveyor head shaft. The design of this conveyor permits change of elevation very rapidly to suit conditions in field. For horizontal changes of conveyor travel, large traction wheels are used.

COIL UNLOADER

This unit consists of a vertical shaft which rotates six horizontal arms. Each of these arms is connected by pivot pins to a rotating head casting, which in turn is keyed to the vertical shaft. Each arm has a vertical lever projection downward, which is equipped with a heavy cam roller running on a cam track as the unloader rotates. The cam track causes the arm, which approaches the conveyor unload station, to raise on an approximate angle of 25 degrees.

Figure 5 — Coils of hot rod are automatically transferred from double-strand chain conveyor to single strand to prevent deformation of coils.



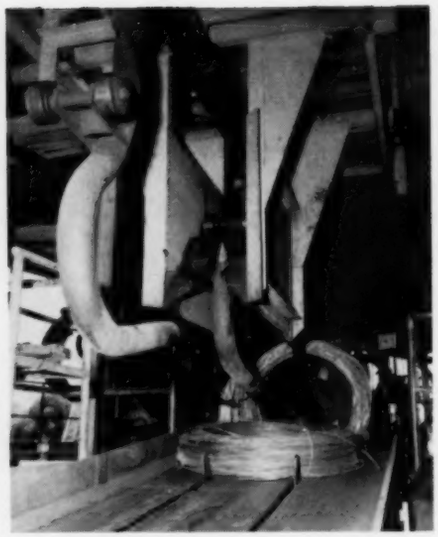
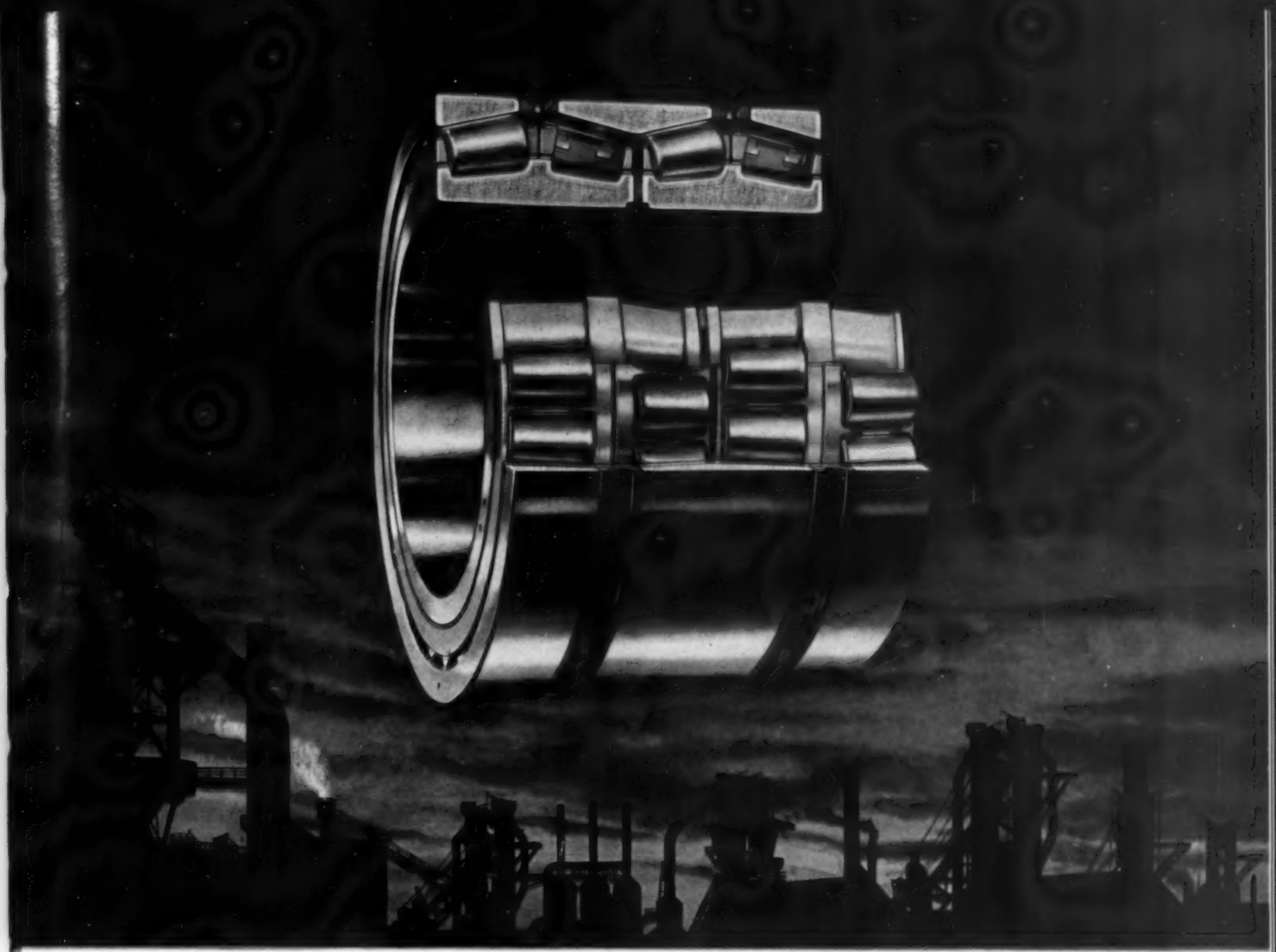


Figure 6 — Coils are automatically transferred from double strand chain conveyor to hook conveyor. Mechanism in the center tilts hook back as shown in order to engage coil when raised by bobbing mechanism.

Figure 7 — Bobbing mechanism receiving coil from double strand chain conveyor. Bobbing mechanism raises coil sufficiently so that hook suspended from trolley conveyor can pick up coil automatically.

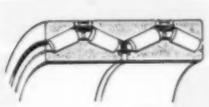
The arm in raised position receives coils from hook conveyor until a preset number of bundles are received, and then the unloader indexes the next arm to the unload position. Coils are removed from unloader arms by crane hooks or ram type tractor.

All conveyor motors are d-c current served by one motor-generator set with variable speed control.



Here's why **TORRINGTON** work roll bearings establish rolling mill records

Highest quality electric furnace alloy steels are used—carburized and heat treated to provide toughness, hardness, stability and uniformity.



Torrington Work Roll Bearings are designed and built with high thrust capacity to give better service under actual operating conditions.

One-piece cast-bronze cages with machined pads in each roller pocket reduce wear, lengthen bearing life and improve performance.

Accuracy in workmanship is characteristic of all TORRINGTON Bearings. This means a lower cost per ton of your finished product.

Many sizes of TORRINGTON WORK ROLL Bearings are available from stock for immediate shipment.

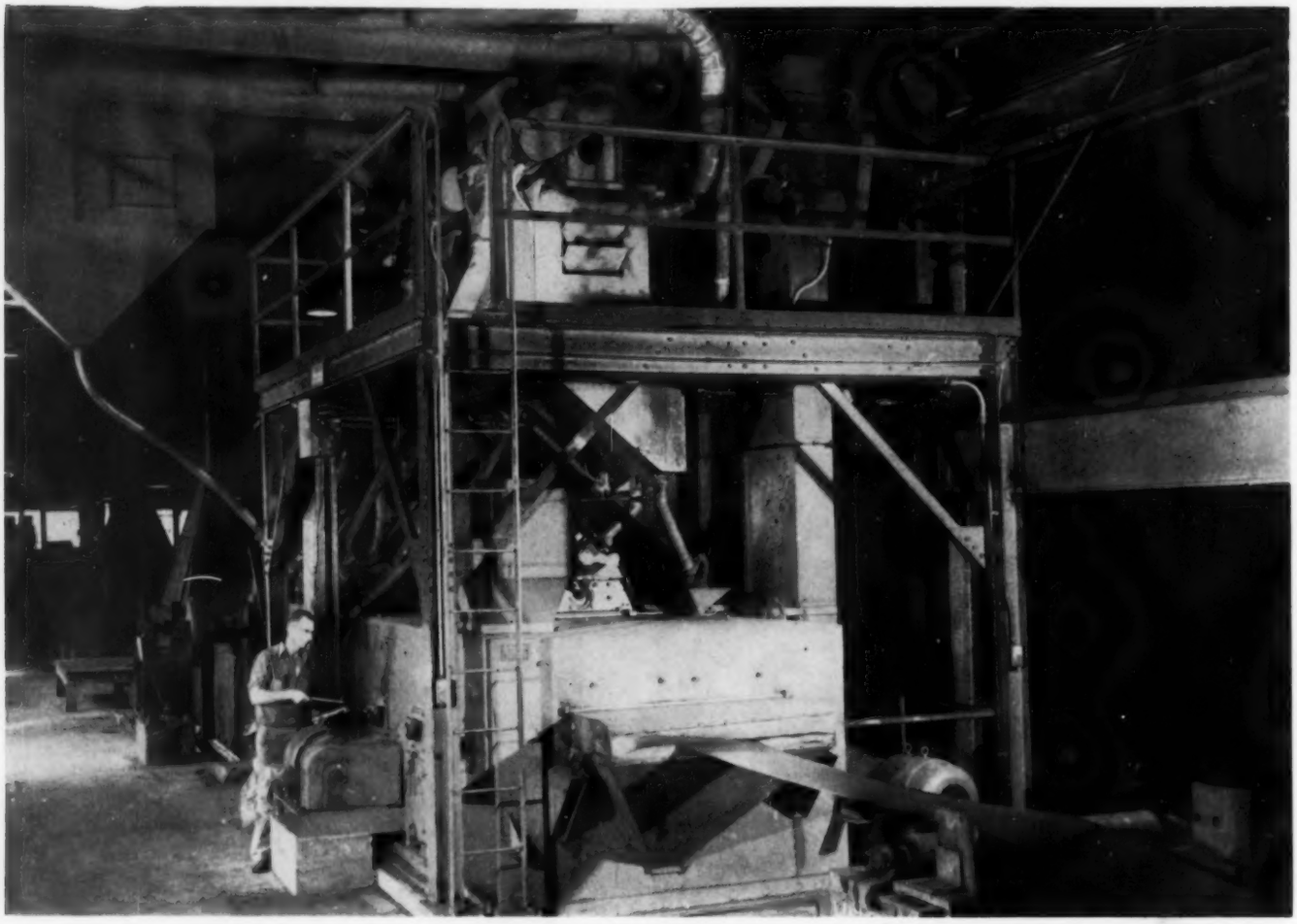
TORRINGTON WORK ROLL Bearings—both two-row and four-row types—are standard in a wide variety of sizes.

For lower operating costs, greater rolling efficiency, less down time...specify TORRINGTON!

TORRINGTON BEARINGS

Spherical Roller • Tapered Roller • Cylindrical Roller • Needle • Ball • Needle Rollers

pioneering developments keep WHEELABRATOR® first in blast cleaning



Steel Strip Descaled without Scale Breaking

More uniform, better quality strip at lower cost with Wheelabrator mechanical cleaning

Advantages of Airless Wheelabrator mechanical cleaning at Washington Steel Corp. in removing scale from stainless steel strip is summarized by Mr. T. A. Fitch, President, as follows: "The Wheelabrator makes short work of the heavy scale with none of the rolled-in scale, coil digs, slivers, etc. so common to cold-rolled methods of scale breaking. It is faster, more efficient, and does a better job quality-wise."

Prior to the installation of the Wheelabrator in its strand annealing and pickling line, Washington bought annealed and pickled coils for cold rolling and finishing. With the Wheelabrator they are obtaining better quality descaling at production line speeds plus a reduction in manpower and reduced use of pickling acid.

Mechanical descaling of steel strip with the Wheelabrator as an integral unit in steel cleaning lines is also returning impressive savings for other steel producers and fabricators alike. Rome Cable Corp., for example, selected Wheelabrating for descaling steel strip because it was the only process that would economically remove surface scale and permit the rest of the plant to maintain its high production without requiring a major portion of its plant area.

Wherever steel is processed in large quantities, the possibilities for saving money with a Wheelabrator are tremendous. Write today for full details.

Bulletin 894 tells how to descale steel strip at high speeds and low cost. Send for your copy today.

American
WHEELABRATOR & EQUIPMENT CORP.
396 S. Byrkit St., Mishawaka, Ind.

Wheelabrator®
AIRLESS BLAST CLEANING

LUBRICANT AIDS IN MAINTENANCE OF STEEL PLANT RAILROADS

By JOSEPH A. RIGBY
Vice President
The Brooks Oil Co.
Pittsburgh, Pa.

▲ STEEL plant trackage maintenance of way is subject to more abuse than common carriers in excessive overloading, short radius curves, corrosive vapors, improperly maintained rolling stock, sulphorous cinders, excessive moisture, corrosive drippage, chemical activity and operating conditions which interfere with adequately scheduled repair work. Any method of simple nature which can be adopted as a corrective measure is considered worthy of presentation.

Common carrier railroads have faced with and met this problem with petroleum products of lead compound nature which serve as a lubricant, but with the utmost in desirable characteristics as a protective coating against corrosion. This has been with severe weather conditions, refrigerator car brine drippage, sea coast salt spray, sulphorous vapors, in tunnels, chemical vapors, alkaline fumes and increased loads on tracks.

Highly prominent in accomplishments is Leadolene-Barcote No. 600 which is a lead compound product with viscosity and pour point for ease of application throughout the year and under any climatical conditions. This product is of solvent cut back nature with a pour point of 0 degrees F for ease of application by pouring, brushing or spraying.

Essential characteristics are: ease of application by flow at zero—will not emulsify with water — adhesive with strong affinity for metals—penetrating action to metals, going through rust and behind scale—is of non-corrosive nature—sets up quickly but never dries hard—has a flexible or rubber-like film — has good wetting or covering action—has lasting or enduring film—resists action of salt water and chemical solutions —is filtered through 0.005-in. screen so cannot clog spray equipment—affords physical and chemical protection — is soluble in petroleum products for ease of removal with common commercial solvents.

Maintenance of way problems which can be improved with Leadolene-Barcote No. 600 are described as follows:

So-called frozen splice bar joints which cause rail breakage, and which prevent fishing movement in expansion and contraction are costly to take apart and reassemble. Leadolene-Barcote can be sprayed behind the splice bars and penetrates through contact surfaces and scale to provide the necessary flexibility and corrosive protection of the joints without removal of splice bars.

Splice bar bolts and nuts, gage rods and other threaded items which become corroded and have to be scrapped by flame cutting torch can be saved by dipping, brushing or spraying applications.

Tie plates, anchors, rail anti-creepers, bond wires, rail clips, rail shims, switch plates, switch tie pads, switch rods levers and toggles, threaded bolts, nuts or articles which must be taken apart or adjusted by turning, and possibly other items subjected to corrosion or abrasion can easily be protected by pouring, brushing or spraying. Protection for flexibility, free movement in cold weather and ease of removal or reapplication in repairs is an assured resultant condition.

Rails in tunnels are subject to rapid corrosion from moisture and acidic conditions. Rails exposed to refrigerator car brine drippage and sea coast salt spray are subject to rapid corrosion, but can be protected by application of this coating, preferably in spray methods.

Structural steel members of bridges, trestles, storage bins, works equipment, marine docks, underground or underwater service and similar conditions are usually fertile subjects to corrosion from moisture, corrosive vapors, chemical action, salt spray and other conditions. Leadolene-Barcote has been tried and proved as a protective coating superior to the highly expensive corrosive protective paints and common paints which have been available.

There may be many other conditions of railroad maintenance of way which exist, however, the preceding description of items is believed sufficient in explanation of the situation in general. Many years of experience in satisfactory results have been attained with the items described in common carrier service to qualify the claims advanced.

In application, the most efficient and economical method is that of spraying. Air pressure is not required as there are air spray cars available with a tank, internal combustion driven pump, exhaust heating equipment, pressure and flow regulators and two sprays with hose for use on each of two rails at the same time. The material was developed for this method of application and with a pour point of zero is applicable under all types of weather conditions.

Of lead compounded nature, but otherwise a pure and highly refined petroleum product without fillers, it may be emphasized that this is a quality product manufactured for severe conditions and enduring results. The constant use by numerous railroads prove the value of such protection and the economies to be attained. Railroads are probably the most price conscious with more necessity for monetary savings than any other type of business organization. Survival as a business requires the utmost in economies because of the unfortunate restrictions in their control of income, costs, labor and competition. Every effort must be exercised in savings with protection against corrosion, a major item. For such reasons the railroads have been receptive to the methods and products described as an aid in survival with reduced maintenance of way costs. The steel industry can also benefit with recognition and application in improved control of corrosion.

Prominent in consideration is that cost of protective coating products, such as Leadolene-Barcote, is usually one-third to one-fourth the cost of paints and special protective coatings.

Jones & Laughlin *uses many* Fuller Rotary Compressors

Like many other steel producers and fabricators, from the East to the West Coast, Jones & Laughlin Steel Corporation has purchased and uses many Fuller Rotaries in its various mills. Illustrated above is a Fuller Rotary Two-stage Compressor, having a capacity of 1660 c.f.m. 120-lb. pressure, installed in the P-1-10″ bar mill of the Pittsburgh Works Division.

Endurance, plus efficiency and maintained capacity, flow of air without pulsations, elimination of vibration, are results of the rotary principle employed in the design of the Fuller Compressor. They can be placed on comparatively light foundations, on balconies or upper floors to save valuable floor space and shorten distribution lines. Employing a minimum of moving parts—rotor, bearings, blades—greatly reduces maintenance and eliminates adjustments entirely.

The cylinders of a Fuller two-stage machine are at ground level, mounted on a common base plate, and are connected by a flexible coupling. Installation is very simple, the motor being lined up to the coupling on the shaft extending from the low-pressure cylinder. This arrangement simplifies motor maintenance work as compared with many other types of machines.

Due to extremely low inertia and WR^2, Fuller compressors, which operate in speed ranges of 600 to 1750 r.p.m., according to size, and are directly coupled to the motor, may be installed with either a general purpose or a normal torque synchronous motor, as dictated by size and the electrical requirements of the plant. Standard motors are available for all sizes of Fuller compressors in either squirrel cage or synchronous types.

For full information, write for Bulletin C-5A.

FULLER COMPANY, Catasauqua, Pa.

Chicago • San Francisco • Los Angeles • Seattle • Birmingham

C259
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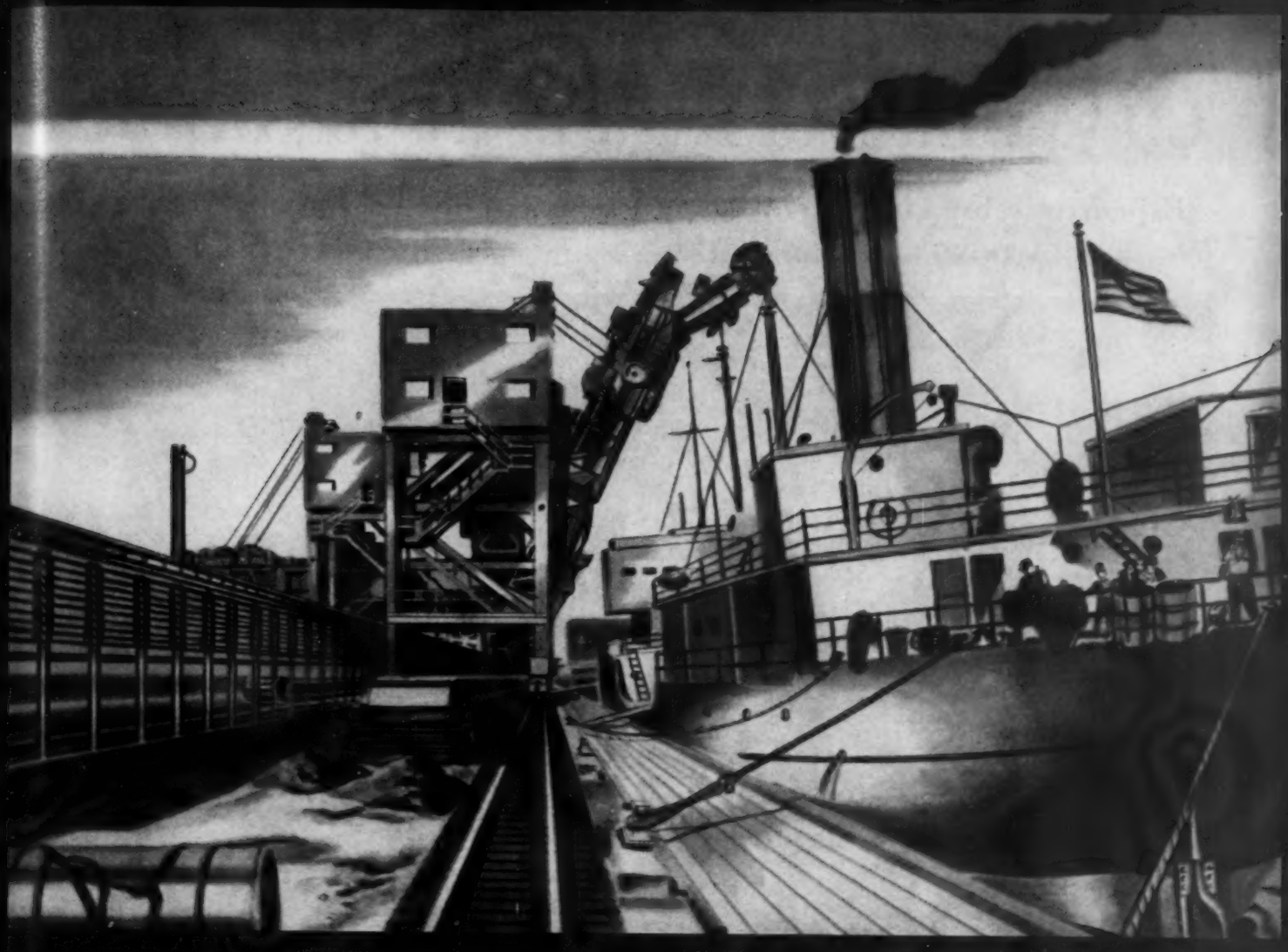
Fuller

PIONEERS OF HIGH-EFFICIENCY VANE-TYPE ROTARY COMPRESSORS



BIG

LOADING TOWER

Alliance

TRAVELING LOADING TOWER

This is one of four coal-loading towers on the 1196-foot-long pier of the C. and O. Railroad at Newport News, Va. Each tower can load 1,500 tons per hour.

There are two towers on each side of the pier. Each tower travels the length of the pier and either, or both towers, can completely service a boat. High-speed rubber belts permit complete loading and trimming without manual assistance and with only one mooring. Telescopic chutes and hinged, retractable booms provide easy docking and loading of all ships regardless of type or beam.

These traveling towers are examples of how **Alliance** designs, builds and installs the versatile, efficient machines that make the big jobs possible and practicable.

When your lifting or loading problems get big, really big, call **Alliance** — world's largest builders of the world's largest cranes.

Give Us The Runway And We'll Lift The World

THE *Alliance* MACHINE COMPANY

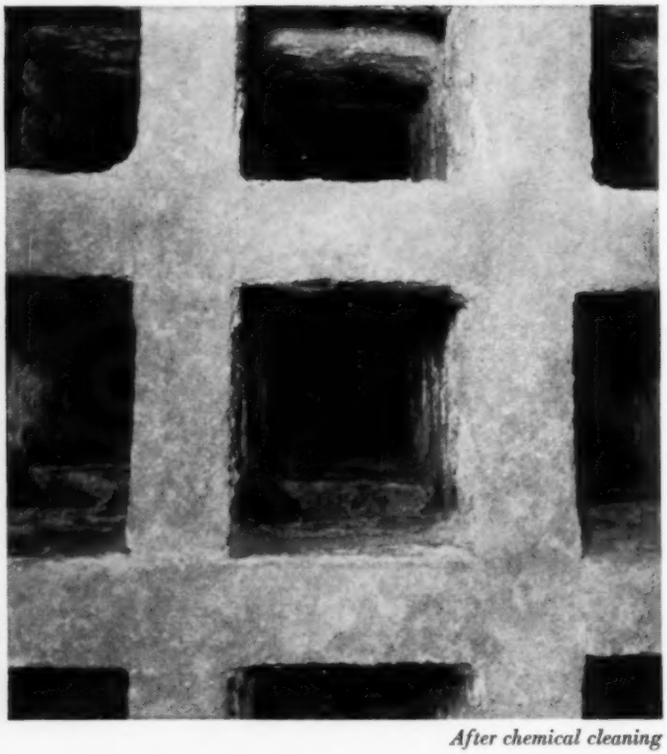
Main Office: Alliance, Ohio

LADLE CRANES · GANTRY CRANES · FORGING MANIPULATORS · SOAKING PIT CRANES
STRIPPER CRANES · SLAB AND BILLET CHARGING MACHINES · OPEN HEARTH CHARGING MACHINES · SPECIAL MILL MACHINERY · STRUCTURAL FABRICATION · COKE PUSHERS

FOUR OPEN HEARTH CHECKER CHAMBERS CLEANED IN 10½ HOURS

Expensive rebricking job avoided; deposits removed from checkerworks by DOWELL engineers using a high-pressure solvent jet

Before chemical cleaning



After chemical cleaning

Recently, Dowell was called to clean four badly fouled checkerwork chambers of an open hearth furnace. A high-pressure solvent jet, designed by Dowell to combine chemical and hydraulic action, made it possible to complete the job in only 10½ hours!

Inspection after cleaning showed the checkerworks to be free of deposits. This cleaning by Dowell Service avoided an expensive rebricking of the checker chambers which would have required a maintenance shut-down of four or five weeks.

This was the fourth time these checkerwork chambers had been cleaned by Dowell—and the fourth time that the operator had been well pleased with the results.

The high-pressure jet is used by Dowell engineers to spray the lateral openings between the bricks, in effect actually scrubbing the refractory surfaces with chemical solvents. The size and shape of the checkerworks seem to have no bearing on the effectiveness of the jet.

Dowell engineers have had extensive experience in cleaning industrial equipment with chemical solvents. Almost every piece of equipment found in blast furnace gas cycles and open hearth furnaces has been cleaned by Dowell. As a matter of fact, some have been cleaned while in actual operation.

Call a Dowell engineer to discuss your maintenance cleaning problems. He'll be glad to make a cost estimate on cleaning your equipment with chemicals. If you prefer, write directly to Tulsa, Dept. K-29.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

Date-line Diary...

October 4

▲ The AISI reports operating rate of the steel industry for the week starting October 4, 1954, is scheduled at 70.4 per cent of capacity. This is equivalent to 1,678,000 tons, which is the same as the previous week, and compares with 2,146,000 tons one year ago. Index of production for week is 104.5.

October 5

▲ Lead advanced ¼¢ to 15¢ a lb, 2½¢ above the year's low set late in February and the highest since October 10, 1952.

▲ United States exports of commercial goods rose to $974,000,000 in August, $63,000,000 above one year ago.

▲ According to the AISI, shipments of finished steel products by steel companies increased 191,000 net tons in August over the 4,681,000 tons shipped in July.

October 6

▲ The Commerce Dept. reported personal income in August dropped to a yearly rate of $285,400,000,000. This was $1,000,000,000 below the rate in August 1953.

October 7

▲ Pittsburgh Steel Co., now operating at 81.5 per cent of capacity, started another blast furnace and placed its cold rolled sheet mill on a three-turn operating basis. Operations will thus step up to 100 per cent by next week.

October 8

▲ F. W. Dodge Corp. reports a new high for future construction in the 37 eastern states with September's contracts in the amount of $1,816,232,000.

▲ General Clay says the United States must spend $101,000,000,000 in the next ten years for new highways and highway system.

▲ Inland Steel Corp. was granted a fast tax write-off on the $14,700,000 addition to its structural steel plant at Indiana Harbor, Ind., for production of wide flange beams.

October 11

▲ Auto dealer's new car stocks dropped to 488,000 units, off 10 per cent a year ago and the lowest since June 1953.

▲ The AISI reports the operating rate of the steel industry for the week starting October 11 is scheduled at 72.3 per cent of capacity. This is equivalent to 1,724,000 tons compared with 1,692,000 tons one week ago and 2,172,000 tons one year ago. Index of production for the week is 107.3.

October 12

▲ Bureau of Mines reported an increase of 7 per cent during August over July consumption of ferrous scrap with 4,254,000 tons scrap in August. Scrap percentage was 50.9 per cent.

▲ Barium Steel Corp. filed with the SEC a statement covering a proposed offering of 599,215 shares of capital stock (par value $1.00), to present stockholders at the ratio of one to every four shares now held. Capital will be used for expansion.

October 14

▲ No. 2 copper wire scrap tumbled to 26½¢ a lb for custom brokers, down nearly 1¢ from the previous day.

▲ Steel scrap prices in Buffalo advanced $4 a ton, the second rise in recent weeks. Today's price for No. 2 heavy melting scrap is $27.50 a ton.

▲ Aluminum Ltd. announced the expansion of its aluminum smelter at Kitimat, British Columbia by 60,000 tons of ingots a year at a cost of $45,000,000.

October 15

▲ Allegheny Ludlum Steel Corp. announced completion of a nine-year plant improvement program. They also reported operating income for the third quarter in 1954 totaled $38,603,712 and net earnings of $546,886 equal to 27¢ a share. This compared with $1.18 a share in the same quarter of 1953 on sales of $58,226,523.

▲ Kaiser Steel Corp. reports net earnings of $969,401 equal to 12¢ per share on net sales of $29,977,214 for the quarter ending September 30, 1954 as compared to net earnings of $3,347,978 equal to 86¢ per share on net sales of $37,658,303 for the same quarter a year ago.

▲ General Electric Co. reached a record $140,691,000 earnings for the first nine months of 1954, an increase of 20 per cent over last year's earnings, on sales of $2,167,397,000 which was down 7 per cent.

October 18

▲ Republic Steel Corp. reported earnings of $10,302,001 or $1.57 per common share on sales and operating revenues of $195,616,821 for the third quarter in 1954 as compared to earnings of $2.30, total sales and operating revenue of $292,627,772 and a net profit of $14,048,033 for the like period in 1953.

▲ The AISI reports operating rate of the steel industry for the week starting October 18, 1954 is scheduled at 73.6 per cent of capacity. This is equivalent to 1,755,000 tons compared with 1,735,000 tons one week ago and 2,142,000 tons one year ago. Index of production for the week is 109.3.

▲ The Aluminum Association reported primary production in the United States for September totaled 240,664,643 lb compared with 250,592,575 lb in August and 218,666,531 lb in September one year ago.

October 19

▲ According to the Labor Dept., home building held a high pace in September with work starting on 114,000 units. This was 3 per cent above the previous month and 20 per cent above the rate in September of 1953.

▲ Reynolds Metals Co. will install a 6000-ton aluminum extrusion press at its Phoenix, Arizona plant.

▲ The ARCI announced deliveries of new domestic freight cars in September 1954 totaled 2566 compared with 2297 in August and 5706 in September 1953. Orders in September totaled 2396 leaving a backlog on August 1 of 11,993.

October 21

▲ Steel makers and scrap dealers are trying to get government to clamp down on scrap exports. They fear large exports will boost scrap prices further and

claim scrap should be conserved as a defense measure. In Pittsburgh No. 1 heavy melting scrap advanced $1.50 to $34 a ton.

▲ Government outlays in the three months ending September 30 topped receipts by $4,900,000,000 which was $1,400,000,000 above the figure in the like 1953 period.

▲ Granite City Steel Co. reports gross sales of $16,132,536 with a net income of $1,049,814 and earnings of 57¢ per common share for the third quarter compared with the previous year's figures of gross sales of $25,335,905, net income of $2,264,329 and earnings of $1.36 per common share.

▲ Allis-Chalmers Manufacturing Co. reported net sales for the third quarter of 1954 of $117,697,258 resulting in a net income of $5,832,964 and earnings of $1.62 per common share as compared to net sales of $132,577,316, a net income of $4,697,061 and earnings of $1.50 in the previous year.

October 22

▲ The Army Dept. placed nearly $1,000,000,000 in procurement and production contracts in the third 1954 quarter.

▲ Blaw-Knox Co. has acquired the stock of Tri-Lok Co. in exchange for 27,000 shares of Blaw-Knox.

October 23

▲ Leading economists of the F. W. Dodge Corp. who predicted the mild turndown in business activity in 1954 expect a moderate improvement in 1955 in their survey. The average forecast for the end of 1955 was only 2 per cent above the most recently reported level for 1954.

October 25

▲ The AISC predicted that shipments of fabricated structural steel during 1954 are expected to reach 3,200,000 tons. This should top last year's total by almost 100,000 tons.

▲ Armco Steel Corp. earned $10,167,361 equal to $1.95 per share of common stock in the third 1954 quarter.

▲ The AISI reports operating rate of the steel industry for the week starting October 25 is scheduled at 74.3 per cent of capacity. This is equivalent to 1,772,000 tons compared with 1,769,000 tons one week ago and 2,132,000 tons one year ago. Index of production for the week is 110.3.

October 26

▲ Jones and Laughlin Steel Corp. announced total sales and operating revenues of $108,702,000 for the quarter ending September 30, 1954, and a net income of $4,387,000 or 65¢ per common share. This compared with the previous year's corresponding period with total sales and operating revenues of $160,504,000, net income of $8,807,000 or $1.36 per share.

▲ Blaw-Knox Co. plans to build a new plant at Matoon, Ill. for the manufacture of road building equipment.

▲ A prediction of President Eisenhower stated that national output will increase from today's $351,000,000,000 to $500,000,000,000 in less than ten years.

▲ Machine tool orders in September climbed to $53,100,000, a 45 per cent increase over July's low.

▲ Barium Steel Corp. announced net earnings after taxes for the third quarter of 1954 amounted to $15,314 or 1¢ per share of common stock as compared with $559,994 or 24¢ per share for the like period in 1953.

October 27

▲ General Motors' third quarter net rose to $1.79 a common share, up from the $1.57 one year ago.

▲ September bookings of fabricated structural steel according to the AISC amounted to 206,606 tons, an increase of 14,000 tons over the previous month and compared to the 217,600 tons in September 1953. Shipments in September totaled 265,388 tons leaving a backlog of work ahead as of September 30 of 1,328,604 tons.

▲ Crucible Steel Co. of America reports net sales for the third quarter of 1954 of $33,834,011 resulting in a net income of $380,632 and earnings of 4¢ per common share compared with 1953's third quarter figures of net sales at $57,880,490, net income of $1,637,566 and earnings of $1.61 per common share.

▲ Inland Steel Co. reported net income for the third quarter of $6,875,977 or $1.37 a share compared with $8,371,796 or $1.71 a share on a smaller number of shares in the like quarter in 1953. Sales were $124,851,788 compared with $149,778,503 in the 1953 quarter.

▲ The Colorado Fuel and Iron Corp. reported net earnings after taxes for the three months ending September 30, 1954 were $1,027,096 with net earnings per share of 33¢. This compared with $2,483,797 for the like period in the previous year when net earnings per share were 94¢.

October 29

▲ Wheeling Steel Corp. reported a net profit for the third quarter of $1,912,920 equivalent to $1.03 per share of common stock. Net earnings for the same quarter in 1953 were $2,939,795 equal to $1.75 per common share.

▲ Westinghouse Electric Corp. netted sales of $401,674,000 with a net income of $17,285,000 or $1.04 per share for the third quarter in 1954 compared with a net income of $17,559,000 or $1.07 per share in the third quarter of last year.

▲ Sharon Steel Corp. reported total sales and revenues of $20,830,715 with a net income of $501,578 equivalent to 46¢ per share for the third quarter of 1954.

October 30

▲ United States Steel Corp. declared income for the third quarter of 1953 as $44,323,860, with earnings of 75¢ per share, compared with $2.12 a share the previous year.

▲ National Steel Corp. reports total sales of $111,126,403 and net earnings of $6,174,370 equal to 84¢ per share for the third quarter of 1954 compared with total sales of $169,605,749 and earnings of $13,003,384 equal to $1.77 a share in the third quarter of 1953.

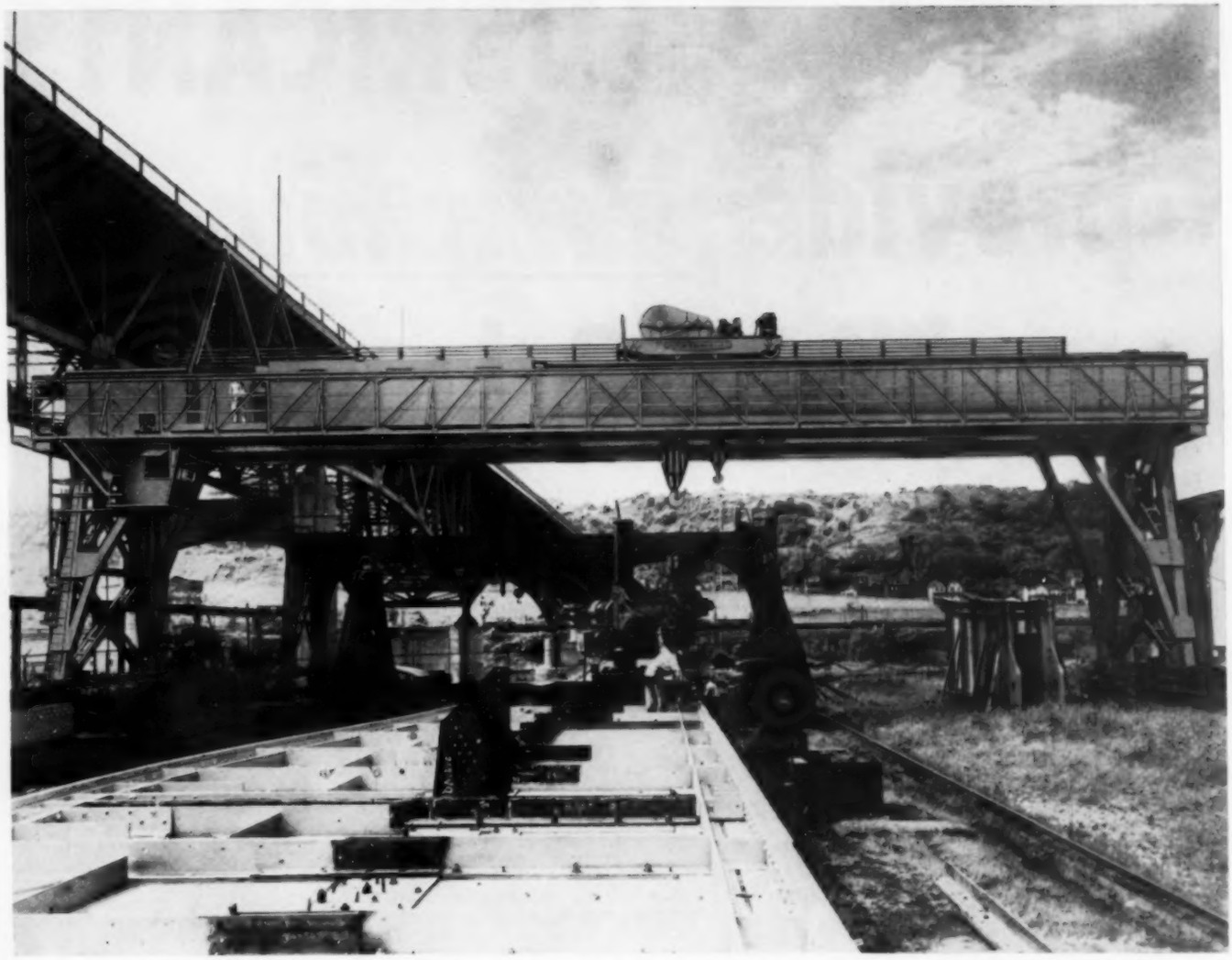
▲ Pittsburgh Coke and Chemical Co. announced total sales and revenues of $8,834,000 with earnings of $13,459,000 or 15¢ per share for the September 30, 1954 quarter compared with total sales of $13,662,000 with earnings of $14,398,000 or 63¢ per share for the like period in 1953.

▲ Interlake Iron Corp. reported net sales and revenues of $46,671,274 with net earnings of $2,114,577 equal to $1.08 per share for the first nine months in 1954 compared with sales of $60,248,087 with net income of $4,027,660 equal to $2.06 per share for the first nine months of 1953.

▲ The Commerce Dept. reported a sharp upward turn in September when durable goods orders climbed to $11,300,000,000. This was a 16 per cent increase over July.

▲ The Army, Navy and Air Force awarded contracts totaling $4,900,000,000 in the July-October period, announced the Defense Dept.

▲ The first shipments of oil left Iran today.



100-ton Bedford gantry crane with 15-ton auxiliary hoist, 130′ span and 30′ lift, owned by a large eastern fabricating plant.

100 Ton Bedford Gantry Crane

This big Bedford gantry crane is equipped with mill type 600 series motors—magnetic dynamic lowering on both main and auxiliary hoists—magnetic reversing plugging control on trolley and bridge motions—Tool Steel Process gears and pinions—eight 36″ straight tread carburized steel bridge wheels. Bridge girders are riveted construction, and each bare girder weighs 92 tons.

All control panels are of the open type, mounted in a walk-in steel control house. Bridge drive is through individual worm drives mounted on each of two bottom bogie trucks controlled by a duplex panel.

The big swing to Bedford Cranes is evidenced by the high percentage of repeat orders from experienced crane users who require and *expect* superior performance.

Backed by more than half a century of *specialized* crane engineering and fabricating experience . . . Bedford Cranes have won fame the world over for advanced design and for safe, smooth dependable performance.

Available in all types and sizes . . . from 5 tons to 350 tons . . . for all kinds of indoor and outdoor service . . . each Bedford Crane is individually engineered for its specific application.

Consult a Bedford engineer on your next crane problem . . . with all the facts on the table we believe you too will make your next crane a Bedford.

Write for complete catalog describing Bedford Cranes in detail

STEEL MILL CRANES BEDFORD

New York Office: 280 Madison Avenue
New York 16, N. Y., Phone MUrray Hill 5-0233

Pittsburgh Office: Oliver Building, Room 1241
Phone ATlantic 1-0136

BEDFORD FOUNDRY & MACHINE COMPANY, INC. • BEDFORD, INDIANA

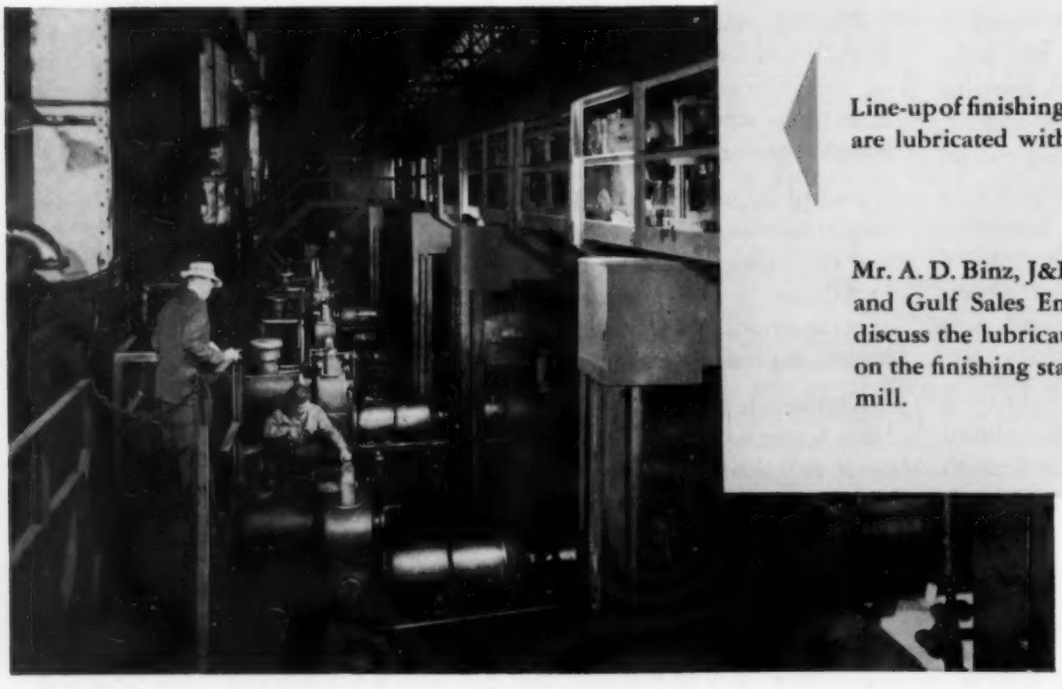
GULF E. P. LUBRICANTS provide *protection plus* on Jones & Laughlin's

Protection plus means that in addition to their extra load carrying capacity, their ability to stick to gear teeth and prevent scoring and welding, Gulf E.P. Lubricants have other advantages that help Jones & Laughlin and many other steel companies get effective lubrication and lower maintenance costs.

They have excellent water separating and rust preventive properties, exceptional stability for this type of lubricant, and effective nonfoaming and noncorrosive characteristics. And because of Gulf E.P. Lubricants' superior film strength, it is often possible to reduce the number of lubricants needed and simplify your lubricant storage and handling.

When you next order gear drive lubricants, make it an order for safe, sure protection and lower maintenance costs—specify Gulf E.P. Lubricants.

For expert help on any lubrication problem, call in a Gulf Sales Engineer. You will find him always on call at your nearest Gulf office.



Line-up of finishing train pinion stands. All are lubricated with Gulf E.P. Lubricants.

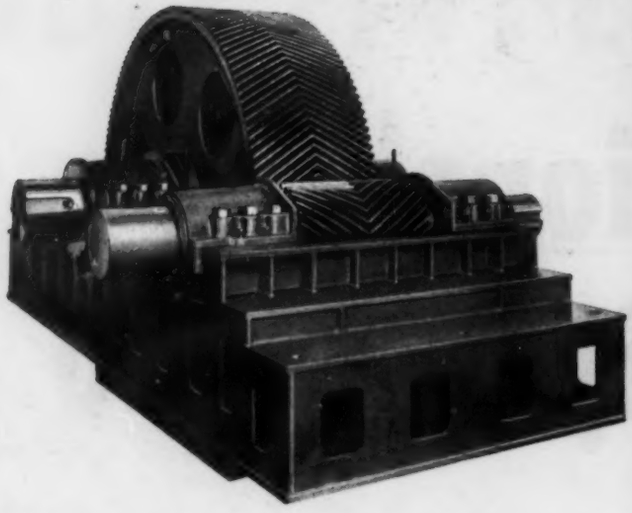
Mr. A. D. Binz, J&L Lubrication Engineer, and Gulf Sales Engineer C. D. Gilchrist discuss the lubrication of the mill pinions on the finishing stands of the 96″ hot strip mill.

for mill pinions 96" hot strip mill

Gulf Oil Corporation · Gulf Refining Company

1822 GULF BUILDING PITTSBURGH 30, PENNSYLVANIA

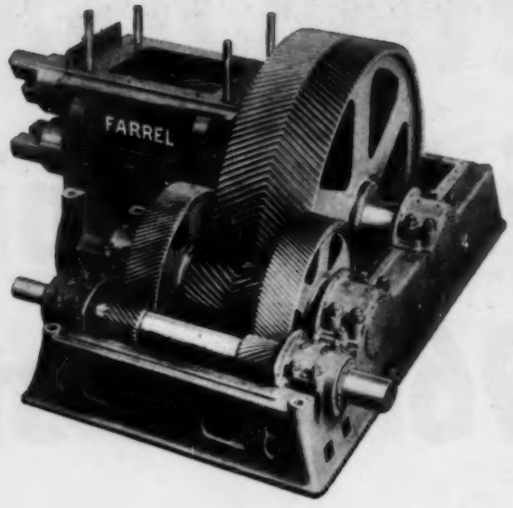
GULF INDUSTRIAL LUBRICATION



5500 HP

SINGLE REDUCTION UNIT

Herringbone-geared reduction unit designed to transmit power to a 134" three-high sheared plate mill, reducing motor speed from 375 to 70.35 RPM.



1000 HP

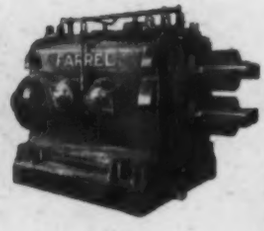
COMBINED DRIVE AND PINION STAND

Designed to transmit power to a two-high cold brass rundown mill. The first reduction gears are opposed single helical and the second reduction gears and the mill pinions are Farrel-Sykes continuous tooth herringbone.

150 HP

TRIPLE REDUCTION UNIT

The three pairs of continuous tooth herringbone gears of this special tube mill drive provide a ratio of 113 to 1. A pinion unit is built as an integral part of the drive.



2000 HP

PINION STAND

21" pinion stand, designed to transmit power to a four-high aluminum sheet mill. The heat-treated, forged steel pinions are continuous tooth herringbone, generated by the Farrel-Sykes process.

TANDEM DRIVE

Transmits power from a single motor to six mills in tandem. Motor is connected to a herringbone gear reduction unit. Power is transmitted to the pinion stands through bevel gears mounted on a line shaft.

What do you need in a mill drive?

Do you need a single, double or triple reduction unit? Do you need a tandem drive, a pinion stand or perhaps a combination gear drive and pinion stand?

Whatever your requirements, no matter how unusual in design, size or capacity, Farrel will meet them. Each unit is individually engineered for the application.

Herringbone, single helical, or a combination of single and double helical gears may be furnished for gear drives. Mill pinions are usually herringbone type, although single helical pinions can be supplied. These gears and pinions are precision generated by the famous Farrel-Sykes process, assuring accuracy of tooth spacing, profile and helix angle, which results in high efficiency and smooth, quiet operation.

Send today for information on these designed-for-the-job mill drives. Or, if you prefer, a Farrel engineer will be glad to discuss your drive problems with you.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Akron, Chicago, Los Angeles, Houston

FB-926

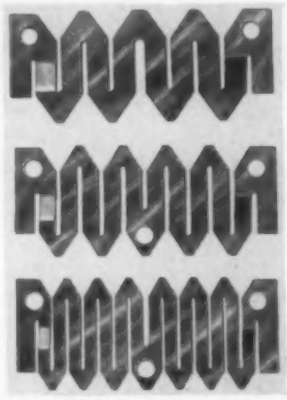
Farrel-Birmingham®

EC&M PLATE RESISTORS
designed for efficiency

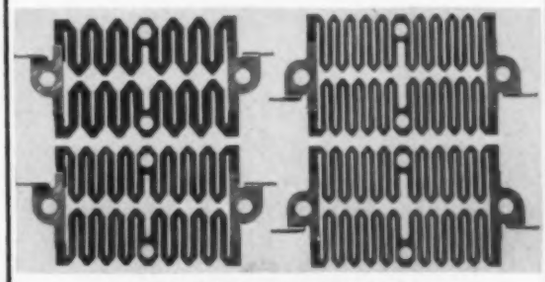
WIDTHS AND OPENINGS MATCHED TO AMPERE AND RADIATION NEEDS

EC&M *Welded Plate* Resistors, available in continuous capacities from 13 to 150 amperes, meet resistor requirements with a minimum number of sizes, and with each size efficiently proportioned to give topmost performance.

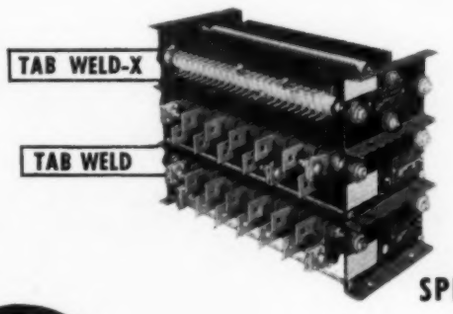
Spacing between individual grids is liberal—from 3/8" to 3/4"—eliminates crowding and permits good radiation. Only insulating spacers are required between grids, because grid-ends mate with adjacent grids, and are welded to provide continuous current-path, independent of end clamping-nut pressure. This construction *stabilizes* the OHMIC value, *stops burning* at grid-eyes and at tap-plates.



Nos. 1, 2 & 3 TAB-WELD Grids
3 thicknesses per design gives 9 sizes



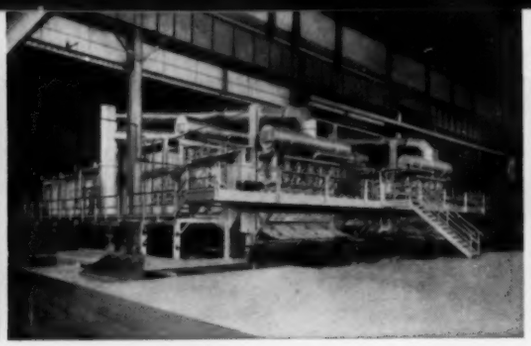
Nos. 4, 5 & 6 TAB-WELD-X Grids
with No. 6 furnished in 2 thicknesses



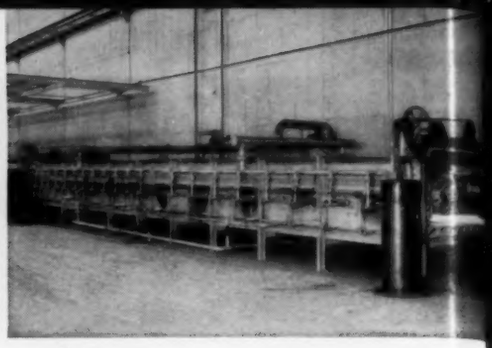
SPECIFY EC&M BULLETIN 942 WELDED PLATE RESISTORS

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

1 One-way fired recuperative soaking pits.



2 Continuous slab and billet furnaces.

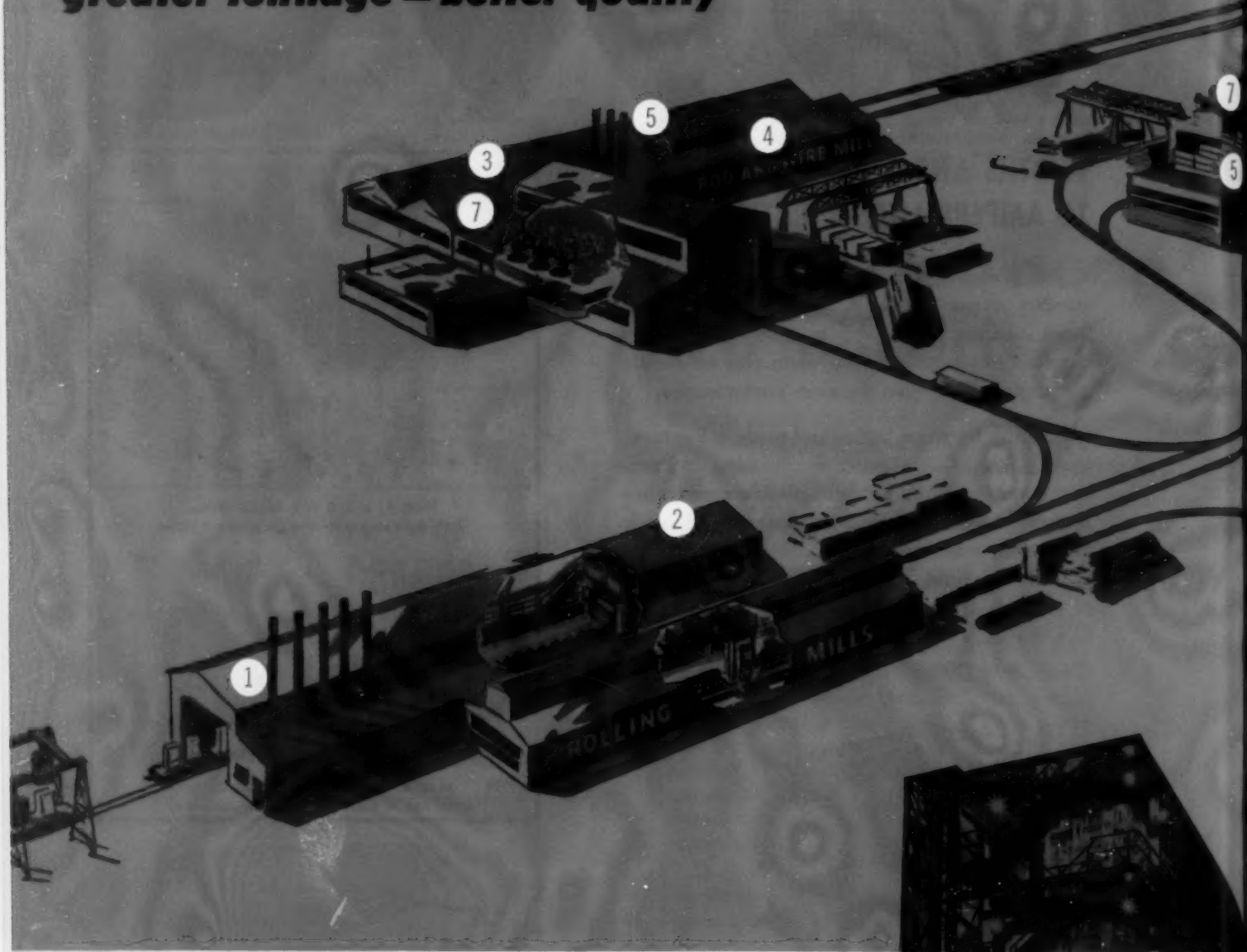


3 Continuous wire patenting furnaces.

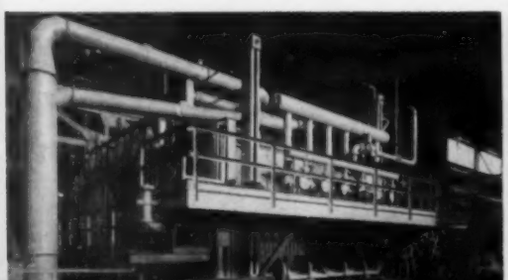
4

DIVIDENDS DECLARED DAILY

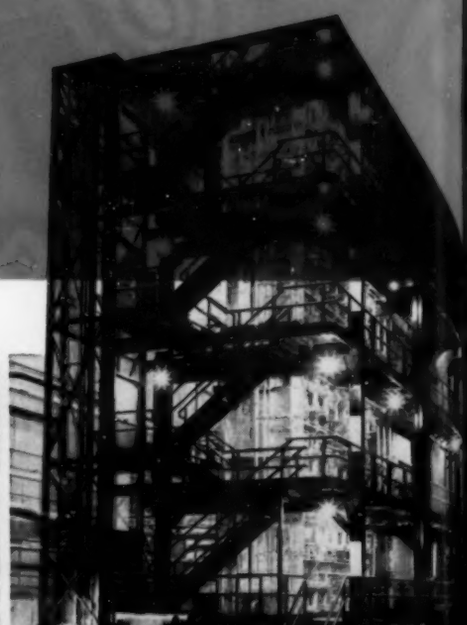
greater tonnage — better quality



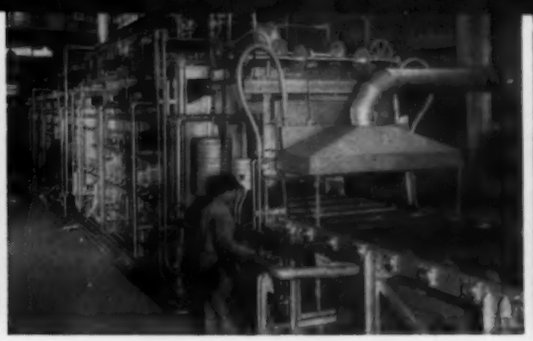
7 Continuous billet reheating furnaces.



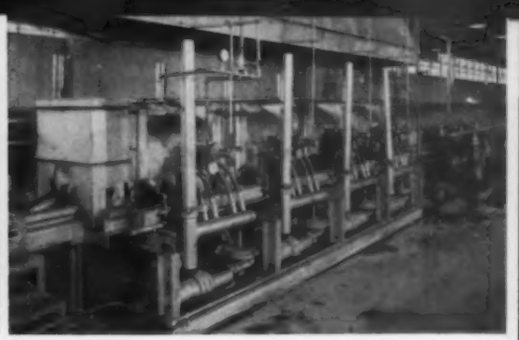
8 Controlled atmosphere coil annealing covers.



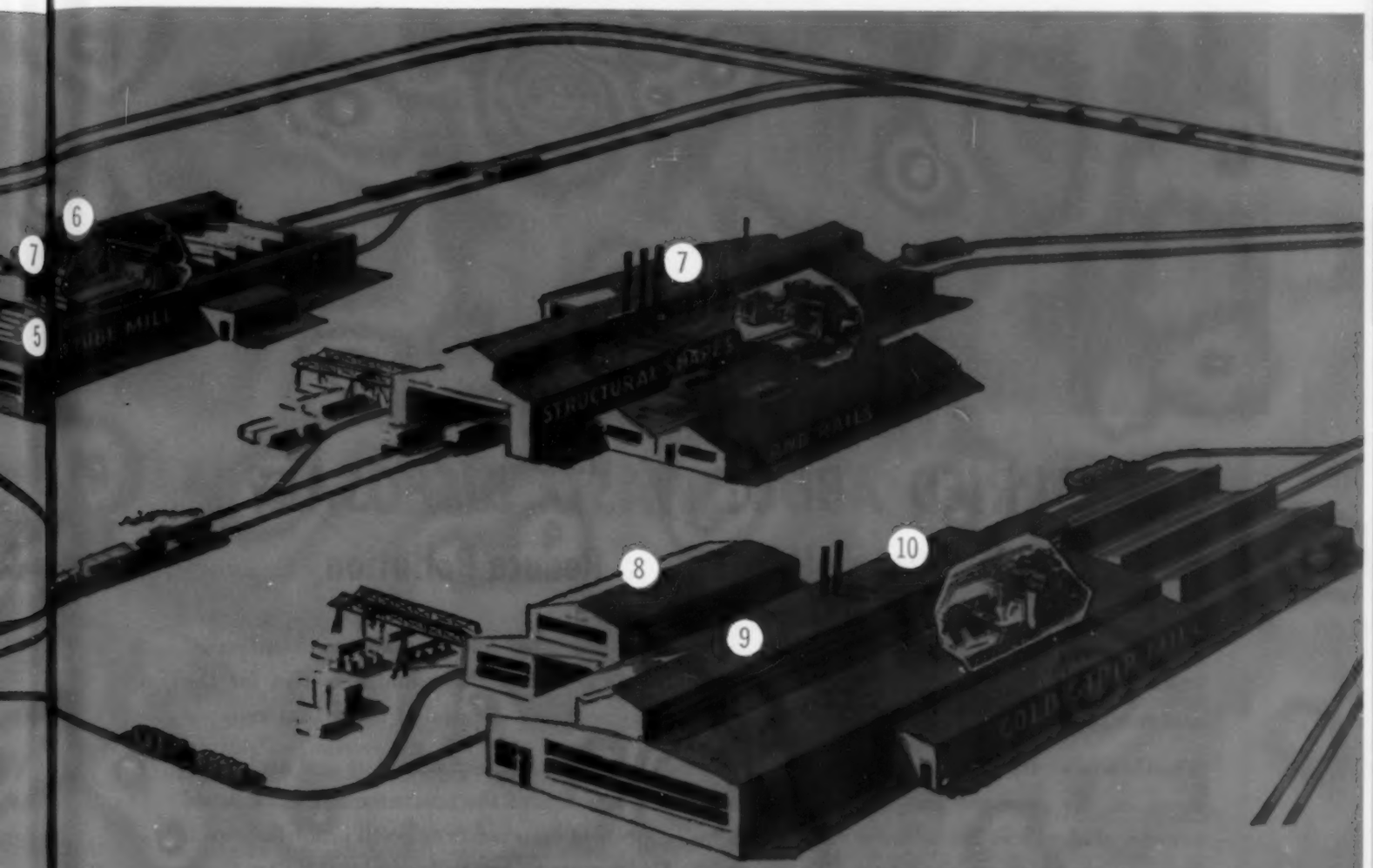
4 Pit type rod annealing furnaces.



5 Continuous roller hearth controlled atmosphere carbon restoration and annealing furnaces.



6 High-speed stress relief furnaces for steel tubing.



Wherever you look in steel mills today, you can find Surface Combustion equipment declaring daily dividends in greater tonnage and precise quality control. These are dividends returned to the customer from 50 years of research, development, and experience in heating and handling steel.

'Surface' furnaces, soaking pits, annealing covers and controlled atmosphere generators have been specified time after time for postwar modernization by steelmen who expect their equipment investments to be gilt-edge securities.

If you are planning an investment in steel mill furnace equipment, put it where it will return dividends every day—in equipment built by 'Surface'.

◀9 Continuous strip annealing furnaces for tin plate.

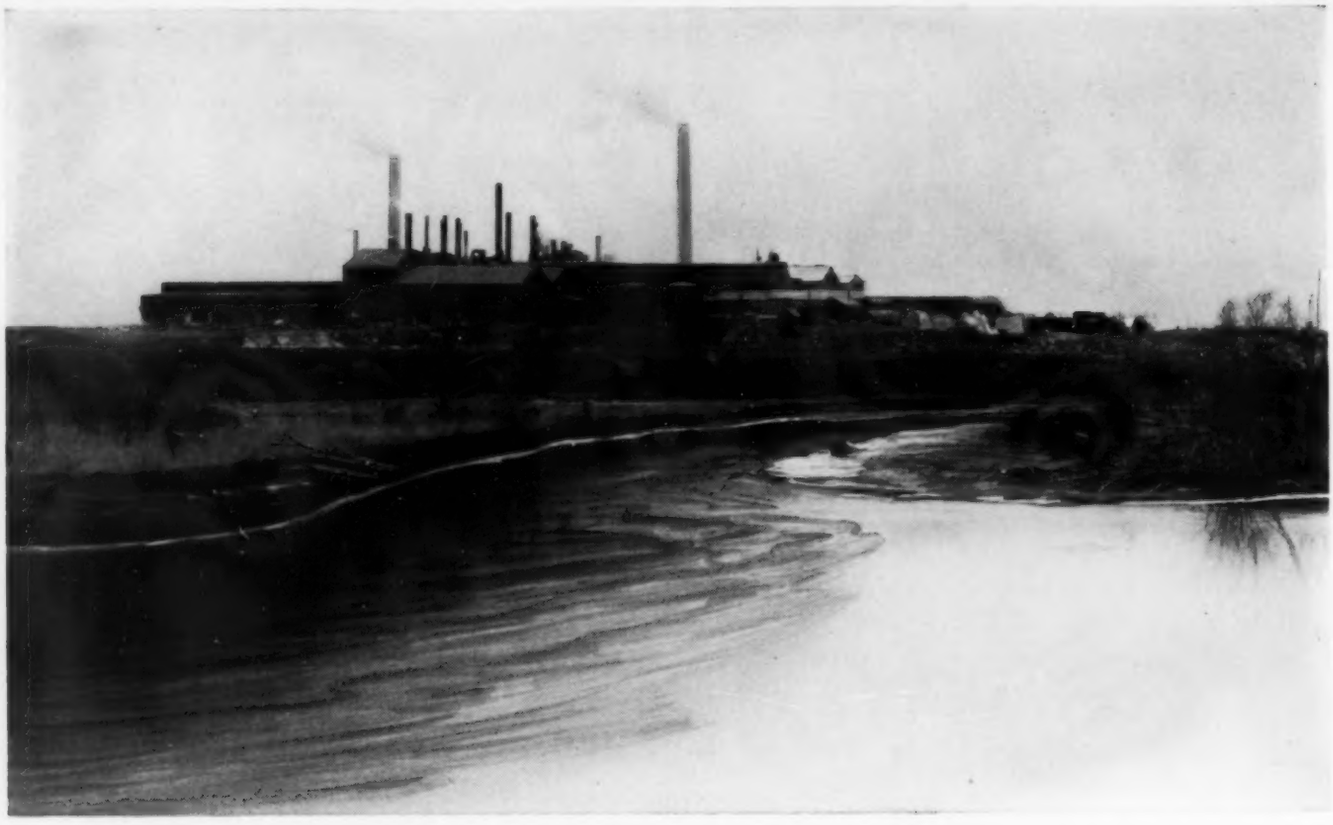
10 Continuous strip galvanizing lines.

Foreign affiliate companies:

British Furnaces, Ltd., Chesterfield
Stein & Atkinson, Ltd., London
Stein & Roubaix, Paris, Liege, and Genoa
Benno Schilde Maschinenbau, A.G., Bad Hersfeld (Hessen, Germany)
Chugai Ro Kogyo Kaisha, Ltd., Osaka

Surface
STEEL MILL FURNACES

SURFACE COMBUSTION CORP. • TOLEDO 1, OHIO



WORRIED ABOUT WASTE DISPOSAL?

Bailey Meters Help you to Reduce Pollution

● The disposal of industrial wastes without stream pollution calls for careful planning and continuous vigilance.

That's where Bailey Meters and Controls come in. We measure the flow and pH of sewage, sludge, and industrial wastes flowing in open channels or pipe lines. These and other factors, such as levels, rates of chemical feed, and flow of air, may be co-ordinated into a completely automatic system for the treatment and disposal of waste materials.

When you want fast, complete and authoritative answers to the measurement and control aspects of your waste disposal problems, reach for your phone and call your local Bailey Engineer. Offices in all principal industrial centers.

P-24

BAILEY
OPEN CHANNEL METERS

These indicating, recording and integrating meters are suitable for measuring industrial wastes, sewage, sludge, corrosive liquids, and irrigation water flowing in all types of open channel primary metering devices, such as Venturi flumes, weirs, or nozzle flumes. Electric or pneumatic telemetering permits location of receivers wherever desired. Ratio of flows and chemical feeds may be controlled automatically.

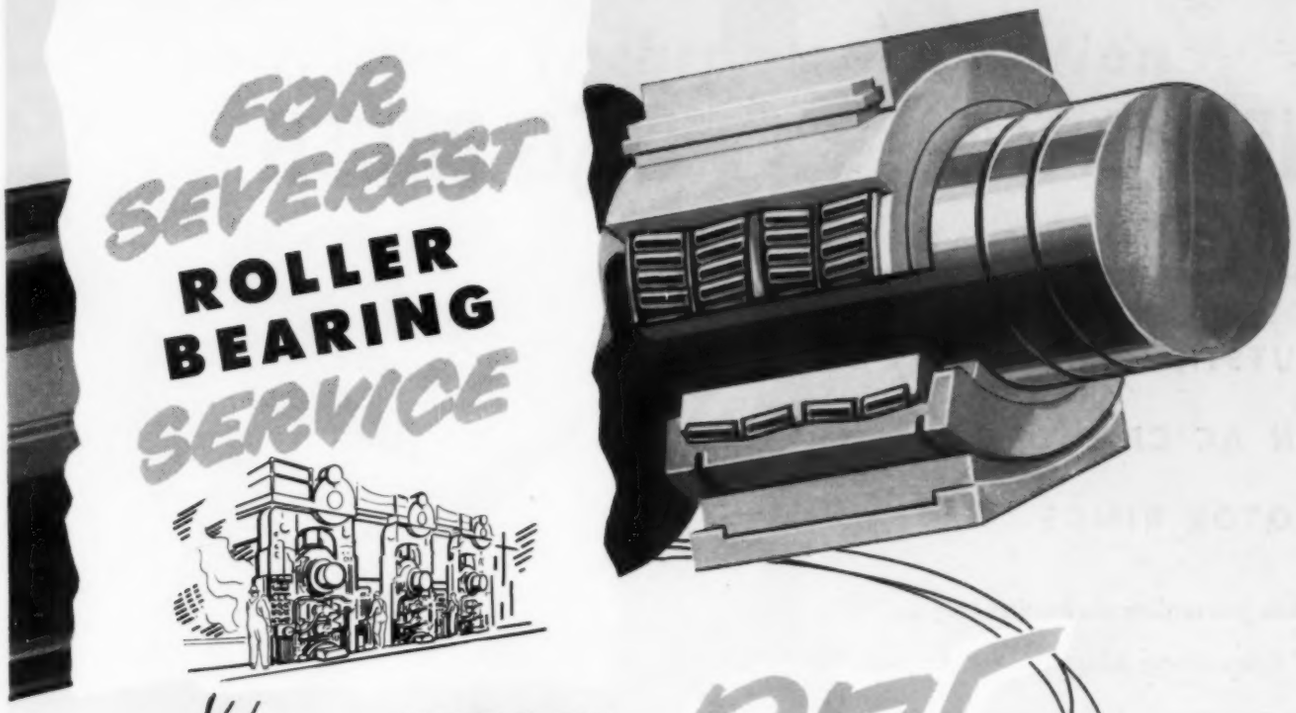
BAILEY METERS

BAILEY METER COMPANY

1047 IVANHOE ROAD
CLEVELAND 10, OHIO

Process Controls
TEMPERATURE · FLOW
PRESSURE · LEVEL
GAS ANALYSIS · RATIO

FOR SEVEREST ROLLER BEARING SERVICE



BROOKS * LEADOLENE 375

*THE I.P. LUBRICANT WITH *Indestructible pH-ilm*

Brooks Leadolene 375 provides safe, trouble-free lubrication of roller bearings under heaviest loads, overloads and severest shock conditions, such as experienced in heavy duty work roll service on 4 high hot strip mills, reduction mills and temper pass mills. Developed through years of research, this modern industrial lubricant provides corrosion resistance to component parts of bearing from cooling water and other contaminating actions.

Available in three grades . . .

Leadolene 375 Light: For normal or moderately high temperatures, with repellence of water a dominant factor. Excellent pumpability.

Leadolene 375 Medium: For heavier load and higher temperature requirements. Prevents leakage through seals. Excellent pumpability. Affords year around service under all temperature conditions.

Leadolene 375 Heavy: For pressure gun or system applications in normal or high temperatures. Good pumpability.

A Brooks lubrication engineer will gladly call at your request. Write, phone or wire today.

THE BROOKS OIL COMPANY
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Pittsburgh 12, Pa.

Please send bulletin on Leadolene 375.

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The Brooks Oil Company

Since 1876

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Executive Sales Offices, Pittsburgh, Pa.
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HERE'S THE USG BRUSH

THAT DOES AN OUTSTANDING JOB ON AC CRANE MOTOR RINGS

When you replace the brushes on your AC Crane Motor Rings you can get the best results with U S G Grade 550 Brush. For brushes that give superb results in other applications, see below. Write for your copy of the complete U S G Brush catalog today.

A typical U S G Grade 550 Brush for AC Crane Motor Rings

194

U S G Grade 135 Mill Motor Brush with Statite*

U S G Grade 223 Brush for DC crane motors with Statite*

U S G Grade 1658 Brush for tin line collector rolls

U S G Grade AH897 Brush for welding generators with Statite*

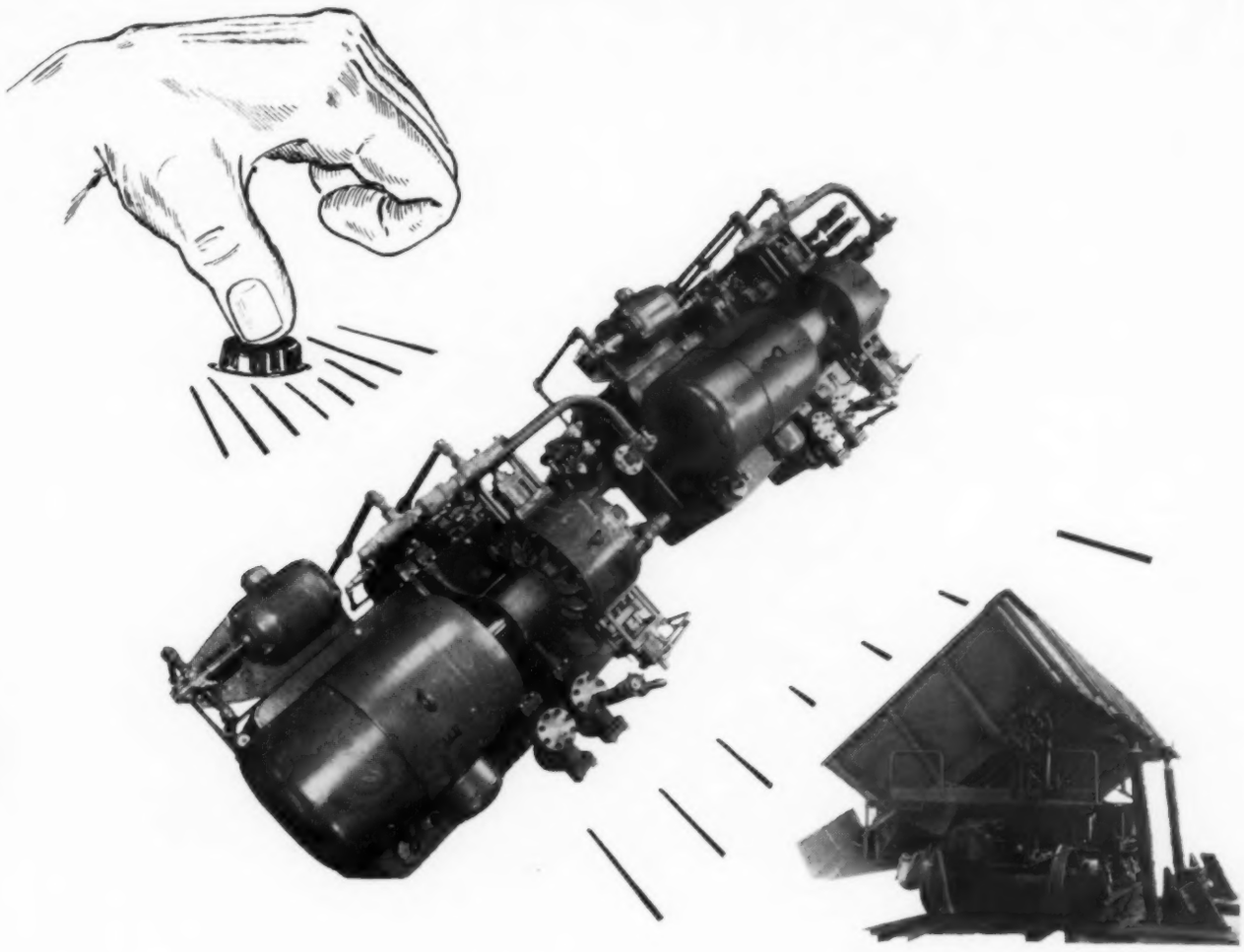
*Permanent shunt connection, needing no hammerclips; cannot be jarred loose or pulled out.

OUR 100th YEAR

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

TWO PUMP SYSTEM
provides synchronized motion *



Keeping two cylinders moving together even though they might be unevenly loaded is a problem. Add to it the fact that these cylinders must be an oscillating type operating at a high volume and pressure input that precludes the use of the usual flexible connectors but rather demands rigid piping. Then consider that the large mass being handled makes a shock-free hydraulic system an obvious necessity.

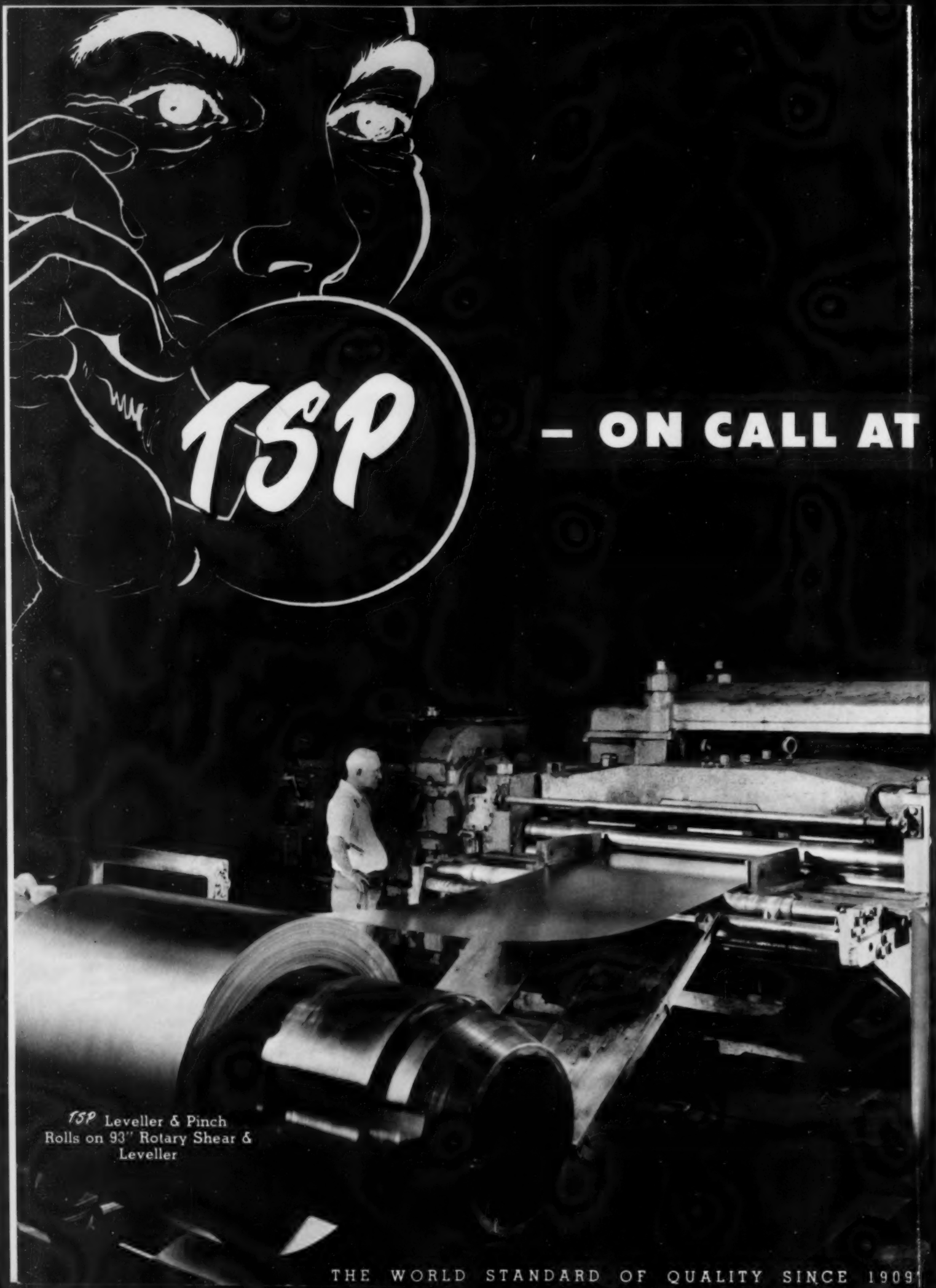
These three design problems have been reduced to a simple matter of push button control in dumping Jones and Laughlin's 70 ton slag cars. And the overall system is safe and efficient as a result of the use of heavy duty components which can stand up under long, hard service.

So if you have a job that can be done best hydraulically, we would like to have the opportunity of showing you the advantages of LASSMAN designed and built equipment.

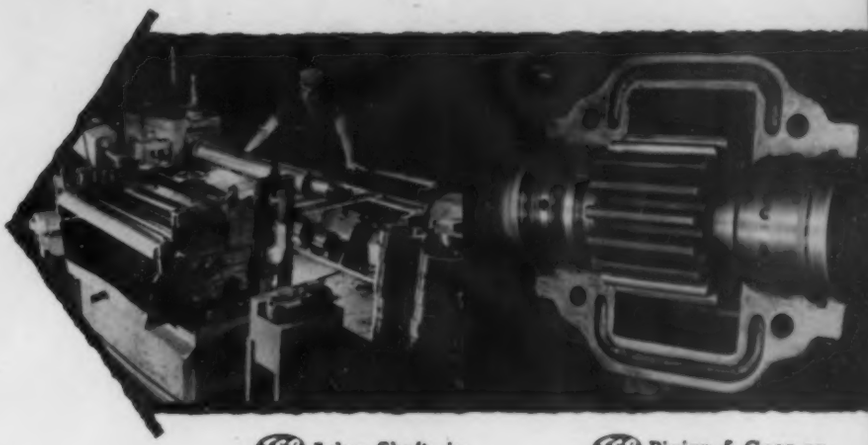
* *Write for your copy of an article by L. Arthur Lassman that appeared in the September issue of Applied Hydraulics.*

Quality EQUIPMENT for *Quality* PERFORMANCE

BENJAMIN LASSMAN & SON Route 8, GLENSHAW, PA.


TSP
– ON CALL AT
TSP Leveller & Pinch Rolls on 93" Rotary Shear & Leveller
THE WORLD STANDARD OF QUALITY SINCE 1909

"Tool Steel Process" products went into J & L in 1909, our first year in business. Today TSP products are used in every operating department covering hundreds of individual applications.



TSP Arbor Shafts in center, TSP Billy Roll at each end of 36" Multiple Slitter.

TSP Pinion & Gear on Soaking Pit Charging Crane in continuous service since 1936. No signs of wear.

T JONES & LAUGHLIN SINCE 1909

Tremendous savings in material and production are being realized by J & L with "Tool Steel Process" products such as: Screw-down Screws, Gears and Pinions for all services; Track and Sheave Wheels; Leveller, Pinch and Backup Rolls, Coiler Carrying Rolls, Arbors, Shafts and Axles; Sprockets, Screws and Nuts, Mill Pinions.

HERE'S WHY: TSP products are hardened by our special process. The file hard surface to full depth of permissible wear gives maximum life. The core, refined for toughness and ductility, gives maximum strength. You receive an absolutely positive written guarantee that TSP products will give a longer life in the same service than any other product.

THE TSP GEAR AND PINION CO.
CINCINNATI 16, OHIO, U. S. A.

AD No. 1007

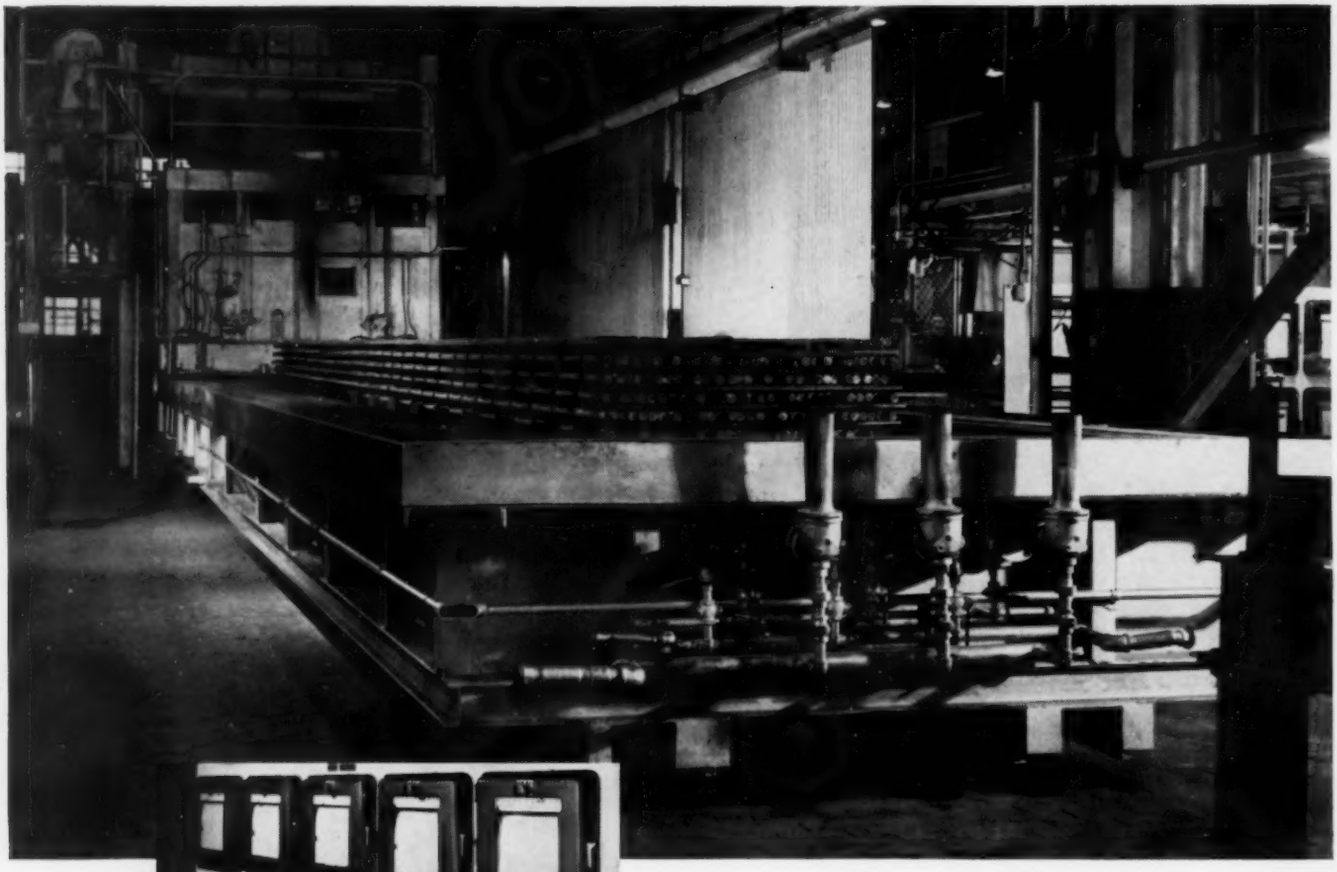
TSP Upcoiler Carrying Rolls on continuous pickling lines.

TSP Leveller, Pinch and Guide Rolls on Scale Breaker.

TSP Wheels on 100-ton coke pusher. Installed 1948. No noticeable wear.

TSP Screws & Nuts on Blast Furnace Clay Gun.

FOR GEARS, PINIONS, ROLLS, WHEELS AND OTHER HARDENED PRODUCTS



Charge of bar stock being loaded into S.C. car-type furnace for carbon restoration in Jones & Laughlin's Pittsburgh plant. L&N Program Temperature Control (on panel) handles entire heating and cooling cycle automatically.

Heat-treating Process Simplified at J&L

WITH LEEDS & NORTHRUP TEMPERATURE CONTROL

• Cold finished bar stock requiring a decarburization-free surface is being produced at Jones & Laughlin's Pittsburgh Works through restoration of surface carbon in a furnace closely regulated by reliable L&N temperature control. Previously this stock from the cold finishing department required expensive handling to remove the decarburized surface.

The temperature control is our P.A.T. system and the furnace is a Surface Combustion Corp. radiant tube installation, with S.C. gas generators. The L&N control incorporates proportional, reset and rate actions to counteract the effect of the various lags inherent in the heating operation.

Control is provided in five zones: three in the furnace cover and two in each of the charge cars. Zones have two thermocouples apiece—one detecting the temperature of the work; the other the temperature of a radiant heating tube. The latter couple protects the radiant tubes by causing fuel to be cut back if maximum tube temperature is reached.

The P.A.T. program control uses motorized front setters, timers and interrupters to bring the heat up at specified rate and hold it for the proper time. Initial and final cooling rates are also held automatically.

P.A.T. program control simplifies the correct treating of a wide range of sizes and grades of steel under varying surface conditions. More information on control for this type of application or any other heat treating process is available from your nearest L&N representative or by writing Leeds & Northrup at 4942 Stenton Ave., Phila. 44, Pa.

LEEDS & NORTHRUP
instruments *automatic controls* • *furnaces*

POOLE

A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

CARBON STEEL ROLLS • OHIOLOY ROLLS • OHIOLOY "K" ROLLS • OHIO DOUBLE-POUR ROLLS • HOLL-O-CAST ROLLS • CHILLED IRON ROLLS • DENSO IRON ROLLS • NICKEL GRAIN ROLLS • SPECIAL IRON ROLLS • NIOLOY ROLLS • FLINTUFF ROLLS

Ohio Rolls

SHAPING METAL FOR ALL INDUSTRY

THE OHIO STEEL FOUNDRY CO.

LIMA, OHIO • Plants at Lima and Springfield, Ohio

Industry News...

JONES & LAUGHLIN TO SPEND $51,000,000 ON EXPANSION AND IMPROVEMENT IN 1955

▲ Jones & Laughlin Steel Corp. announced that they will spend almost $51,000,000 to improve and expand its plant and equipment in 1955. The new projects will enlarge and improve the pattern of products which can be produced from steel rolled on present facilities.

Most important of these projects are:

1. Additional equipment for producing new joint sections at the 14-in. bar mill at J&L's Aliquippa, Pa., Works.

2. Additional facilities at Aliquippa for the production of high strength and special seamless tube products used in the oil industry. Deep well requirements have broadened the market for stronger and heat treated pipe.

3. An electricweld pipe mill at Aliquippa designed to produce pipe for the oil industry and broaden the scope of their market.

4. Improved and additional wire and wire specialty manufacturing facilities.

5. A continuous sheet galvanizing line at Pittsburgh. Although details on this are not entirely settled, location of this line will be in the Soho District on Second Ave., in Pittsburgh. Product will probably range up to 48-in. wide in 14 to 30 gage thickness. Capacity will be about 78,000 tons a month.

6. Also under consideration is transferring one electrotinning line from the alkaline to the halogen process, because of greater demand for dual-coated tinplate.

J&L's expenditures for plant and equipment for the nine months ended September 30 were $22,000,000 and will approximate $29,000,000 in 1954.

NEW BUILDING UNDERWAY AT WEIRTON TIN MILL

▲ Now under construction at the tin mill of the Weirton Steel Co. is a four-story building which will house a new continuous cleaning and annealing line plus other facilities and warehouse space.

The new line will be located on the fourth floor of the building which will be 560 ft long, 122 ft wide and 110 ft in height. The third floor of the structure will contain electrical substations and hydraulic, air cleaning and neutral atmosphere equipment, while the first and second floors will be utilized for tin plate warehouse storage. Construction will be completed in mid-1955.

The new continuous cleaning and annealing line will handle 60,000-lb coils of cold rolled strip steel up to 45-in. wide in tin plate gages, and will operate at a speed of 2000 fpm.

Steel coils from the tandem mills will go to the line, which will clean and anneal 60 tons of strip per hour, and from there will be transported over a bridge to the present tin mill annealing building, ready for skin rolling and tin plating.

The present tin mill floor is at an elevation of 730 ft above sea level, with adjacent ground sloping toward the Ohio River. The first floor of the new building will be at elevation 683 ft, making a total height of 47 ft from the first floor to the fourth or operating floor of the tin mill. The building connecting the tin mill and the new structure will house four shearing lines.

A large elevator will service all floors of the building in which the cleaning and annealing line will be located, while small fork trucks will be used to move material in the tin plate warehouse. A 30-ton crane will be installed 38 ft above the fourth or operating floor for lifting coils and other material.

The entire structure will be carried on concrete foundations supported on rock base, and the column loads will be approximately 4000 lb each.

The building, to be constructed of insulated panel, is designed for the future addition of facilities.

ALUMINUM BATH PROTECTS AGAINST CORROSION

Engine manifold is removed from molten aluminum bath with approximately .0005 in. to .001 in. aluminum coating on its surface. A metallurgical iron-aluminum alloy bond is produced at the interface. This process, known as "Alumicoat," has been instituted by Arthur Tickle Engineering Works, Inc., under license from General Motors Corp. to protect metals against corrosion and high temperature oxidation.

TO REHABILITATE RAIL MILL AT BRADDOCK

▲ The installation of new, modern reheating furnace facilities and relocation of roll stands has been announced for the Edgar Thomson

HERE is the ideal CHECK VALVE for tanks and other vessels

When used with tanks (as shown here), dry cans, retorts and pressure vessels of all kinds, the DURABLA Check Valve Unit is the lowest cost, high-quality valve you can buy.

LOW COST—The cost is low because all you buy are the working parts. The vessel wall acts as the valve body.

HIGH QUALITY—Made of stainless steel (or a combination of stainless steel and Ni-resist), these valves will handle practically any liquid, gas or air—at all temperatures and pressures. They will operate in any position.

DURABLA Check Valves are available in seven standard line sizes, from ⅜" to 2". Ask your distributor for complete information or write us direct for bulletin P-1. DM-15

DURABLA

DURABLA MANUFACTURING COMPANY

114 Liberty Street, New York 6, N. Y.

Visit our exhibit, Booth 700, National Power Show, Philadelphia, December 2, 3, 4, 6, 7

Works of U. S. Steel Corp. This follows the work started earlier this year to provide facilities for end-hardening of rails.

The entire project is scheduled for completion next year. The output of rails which has been produced on Nos. 1, 2 and 3 rail mills will be handled by Nos. 2 and 3 mills.

This realignment of Edgar Thomson Works' rail rolling facilities follows railroad progress. With trains traveling at greater speeds the demand has shifted from lighter weight to heavier rails. No. 1 rail mill which has long been the plant's producer of light rails will be abandoned. With the new setup, production of lighter weight rails will be handled by No. 3 mills and No. 2 will produce heavy rails.

Plans now call for rehabilitation work to begin on No. 2 rail mill within several days. Very little shutdown time on rail production on No. 2 mill is anticipated during the entire installation period.

Another major step in modernizing No. 2 will be the relocation of roll stands to permit the rolling of three standard length rails from one bloom. At present, two rails are obtained from one bloom.

INLAND STEEL TO ADD THIRD GALVANIZING LINE

▲ Inland Steel Co. announced plans for an expansion of more than 60 per cent in the company's capacity to produce galvanized steel sheets. A third continuous line for their production by a process for coating sheets with zinc will be installed at its Indiana Harbor, Ind., works. Construction will start in December and should be completed by the end of 1955.

This is the second major expansion for the company this year. In June it started construction of a wide-flange beam mill, the second to be built in the Chicago district and making Inland one of three producers of this structural shape.

Inland placed its first continuous galvanizing line in operation May, 1951, and added a second in May, 1954, at which time it discontinued the old process of coating individual sheets by dipping them in pots of molten zinc. It was the first steel company to produce all its galvanized sheets by the new process.

EXPERIENCE PROVES IT BEST BY FAR

for BLAST FURNACES
COKE OVENS • SOAKING PITS
ANNEALING FURNACES

SUPER #3000 Bonding Mortar

SETS HARDER

BONDS STRONGER

LASTS LONGER under severe service

The "Wonder Cement" that steel mills have standardized on for best resistance at high or low temperatures

Mill after mill is making terrific savings in refractory costs because of the remarkable range of usefulness and durability of Super #3000.

This ready-to-use, plastic mortar bonds brick-to-brick joints of weld-tight resistance to shrinkage, spalling, abrasion and wear.

As a surfacing and sealing wash coat, Super #3000 is practically impregnable, adding service life to existing refractories, cutting down-time to a minimum.

For hot patching, Super #3000 renews existing refractory construction and adds useful life; otherwise complete replacement would be necessary.

There's simply no bonding mortar to match Super #3000 for effectiveness. It can be troweled, dipped, brush coated or sprayed—and air set—to full effective strength. None matches it for lasting quality.

Get the full Super #3000 service story. It will amaze you.

REFRACTORY & INSULATION CORPORATION

R&I Refractory Bonding and Castable Cements — Insulating Block, Blankets, Cements

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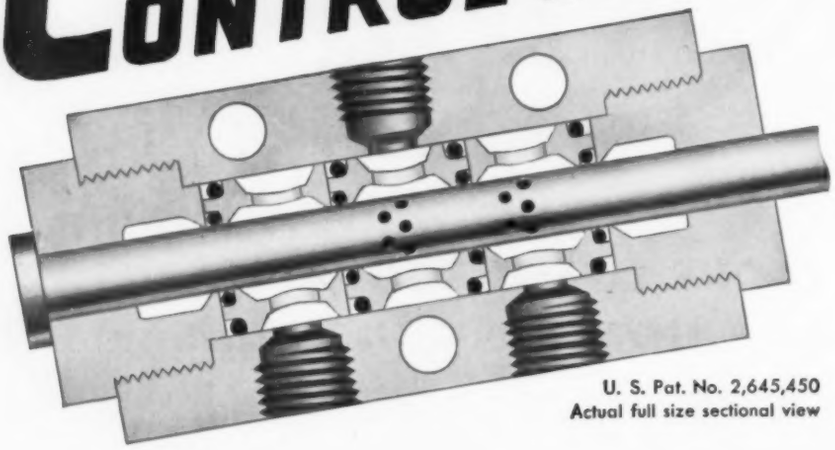
NEW, INEXPENSIVE, HIGHLY EFFICIENT

Quick-As-Wink®

CONTROL VALVE

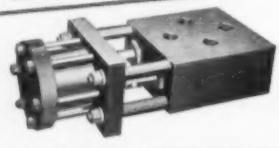


U. S. Pat. No. 2,645,450
Actual full size sectional view

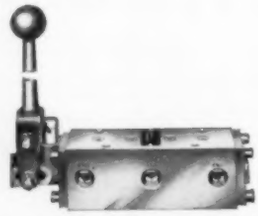
COMBINES greatly simplified construction, positive positioning of all parts, and quick and easy repacking in the field.

• Internal spacers are held firmly and accurately in metal to metal end abutment when the gland nuts are tightened, holding the "O" rings in correct position, without subjecting them to any mechanical pressure. Flow is from the inlet chamber through the hollow, radially ported, stainless steel plunger, and out the connected line. No direct impingement of flow across the packings, greatly prolonging their life. ⅛" or ¼" pipe connections. 2, 3, 4 or 5-way actions. Push-pull; push, spring return; lever; foot; cam; pilot; diaphragm and single and double solenoid designs. Write for Bulletin No. 531 today! *It gives full details.*

Ask us also about . . .



PILOT CYLINDER HYDRAULIC VALVE pressures to 5000 psi. Usually placed close to the work and controlled with an easily operated and conveniently located air valve.



SINGLE PLUNGER AIR VALVE, ⅜" to 1½" sizes. Widely used for controlling single and double acting cylinders and as pilots for other valves

Quick-As-Wink
AIR AND HYDRAULIC
Control Valves

Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

Mfd. by C. B. HUNT & SON, INC., 1923 East Pershing St., Salem, Ohio

The projected line is scheduled to have the capacity to produce 80,000 or more tons annually, varying according to the weight and width of the sheets being coated. The two existing lines are producing currently at an annual rate in excess of 130,000 tons.

ARCH PIPE FACILITIES SCHEDULED FOR NEWPORT

▲ New facilities for producing a wide range of arch pipe will be installed at Newport Steel Corp.

Manufacture of arch pipe marks an additional step in Newport's program for a further diversification of end products, supplementing the list of electric weld line pipe and corrugated round pipe already being produced.

The new arch pipe equipment, together with recently installed bituminous coating facilities, now places Newport Steel in position to provide a complete line of corrugated pipe products, including all types of round and arched pipe with or without bituminous coating.

The new facilities are part of a $9,000,000 expansion and modernization program underway at Newport Steel. Major items include a new reversing hot strip mill, installed last summer, and a mill for cold rolling steel, which is expected to be in operation by early 1955.

ALABAMA FIRM APPOINTED DWIGHT-LLOYD AGENT

▲ Dwight-Lloyd, Inc., division of Sintering Machinery Corp., announces the appointment of General Machinery Co., 1600 Second Ave., South, Birmingham, Ala., to handle their complete line of continuous weighing and feed regulating scales in northern Alabama.

BLAW-KNOX ACQUIRES METAL GRATING FIRM

▲ The outstanding capital stock of the Tri-Lok Co., grating fabricators, has been acquired by Blaw-Knox Co.

The joint announcement was made by W. Cordes Snyder, Jr., president of Blaw-Knox, and A. J. Diebold, who has been president of the 28-year-old Tri-Lok firm.

One of the pioneers in the grating field, Tri-Lok makes mechanically in-

terlocked open metal flooring, or grating, in both steel and non-ferrous metals, and steel bridge decking. These products will be added to the Blaw-Knox commercial and railroad grating lines.

Blaw-Knox plans to operate the plant as a branch of one of its nine operating divisions.

ANNOUNCES CHANGE OF DIVISION NAME

▲ The Torrington Manufacturing Co. has changed the name of its Spring Machinery Division to the Wire Forming Machinery Division so that the name will more adequately describe the function of that particular phase of the firm's machinery operation.

Andrew Gagarin, president, said the change is being made because the company has gone into the manufacture of four slide machines, torsion spring winding machines and precision carbide tools for spring machinery.

Output of the division formerly was limited to machines designed for the production of conventional extension and compression springs.

PURCHASE ASSETS OF SHERMAN ELECTRIC

▲ The physical assets of the Sherman Electric Co., Inc., have been purchased by the Peerless Electric Co. Peerless has also obtained an exclusive license to manufacture and sell all products covered by Sherman patents. The Sherman Electric Co. remains as a royalty holding company.

Sherman patents cover a number of electronic devices including the "Restorer"—a device developed to quickly check and correct faulty thermocouple circuits.

A. M. BYERS CO. OUTLINES THREE-POINT PROGRAM

▲ Plans for revising the A. M. Byers Co. capital structure, modernizing certain plant facilities, and diversifying its line of products, was announced by President A. B. Drastrup.

He stated in a letter to stockholders that the company has adopted the following three-part program:

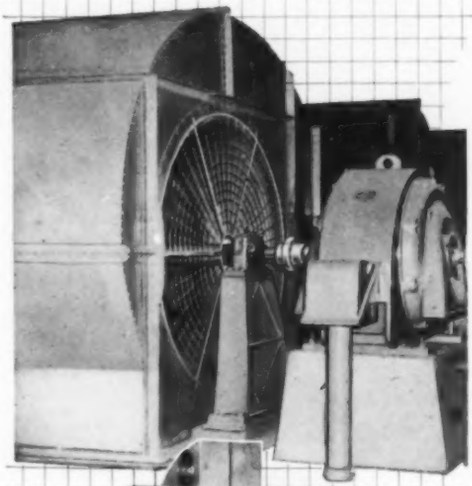
1. Discussions are under way with a New York investment house with

WALDRON

ADVANCED DESIGN

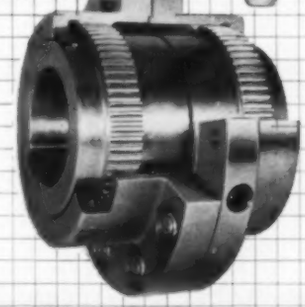
GEAR COUPLINGS

are available in all types and sizes for all applications

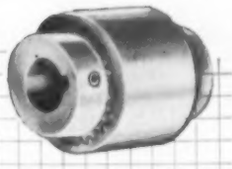


Whatever your drive problem, there's a WALDRON Coupling to meet it. All-steel couplings for rugged work, all-nylon couplings where the corrosion problem is present, combinations of both for a variety of special problems.

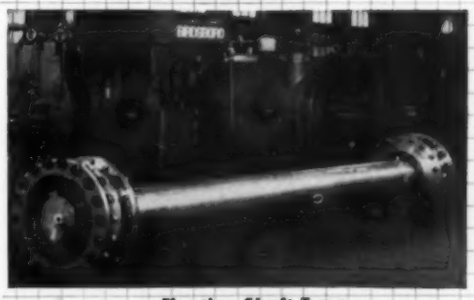
Whichever you use, the WALDRON design and construction is your assurance of long trouble-free service. The best known name in Couplings — WALDRON!



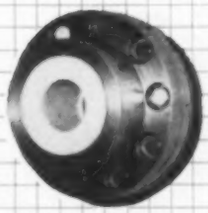
Above—Steel Coupling On Tunnel Fan



Above—All Nylon, Non-Corrosive Type



Floating Shaft Type For Steel Mill



Combination Nylon Hub and Steel Sleeve

WALDRON couplings are available in sizes up to 18" shaft diameter. We specialize in furnishing couplings for unusual applications and services. We would be pleased to send you our latest bulletin 551 upon request.

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New Brunswick, N. J.
Since 1827

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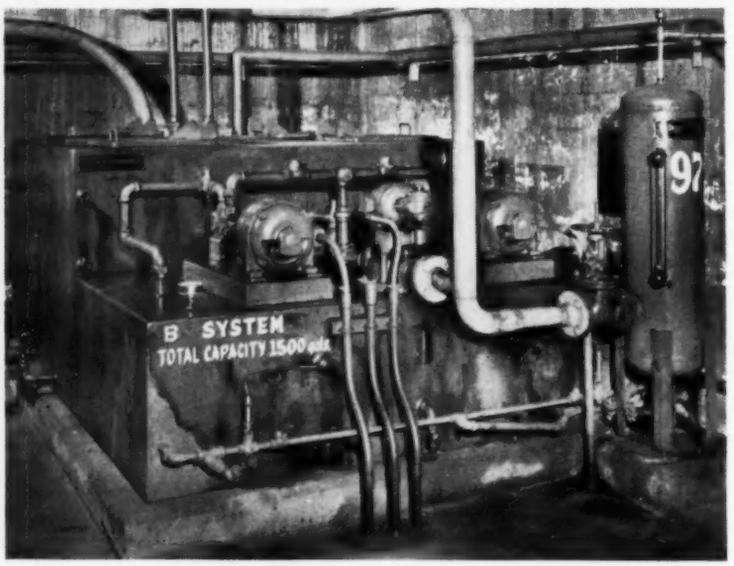
SHEFFIELD STEEL CAME TO DE LAVAL FOR CUSTOM-DESIGNED MILL LUBRICATION



Part of Lubrication System B, Sheffield Steel Co., Kansas City

When Sheffield Steel added a 12″ continuous merchant mill to their Kansas City plant they put the entire lubrication problem up to De Laval.

They *knew*, from the success of De Laval-engineered systems in other large mills, that the *four essentials* of dependable and economical lubrication would be provided.

They *knew* they would get proper pipe sizes to minimize line friction and maintain streamlined flow . . . correct metering of lubricant at every gear mesh point and bearing . . . efficient control of oil temperatures in all seasons . . . thorough purification.

And they *knew* that all accessories such as pumps, tanks, valves and fittings would be *right*.

When you plan to build or revamp, let De Laval take care of the lubrication—either with a De Laval custom-engineered system or, if the requirements are 50 gpm or less, with a "packaged" De Laval Unilube.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York • 427 Randolph St., Chicago 6
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DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5

DE LAVAL ENGINEERED MILL LUBRICATION SYSTEMS

emphasis on refinancing 42,277 shares of outstanding 7 per cent preferred stock and obtaining additional capital.

Mr. Drastrup's letter declared that the company has retired 9,062 shares of preferred stock since Jan. 1, 1950.

2. The company will install new-type facilities for production of wrought iron pipe in sizes comprising 45 to 50 per cent of its total pipe production, in order to reduce production costs and improve quality of product. These new facilities will cost up to $2,000,000.

Studies are also under way, Mr. Drastrup said, for improving the balance of the company's pipe-producing facilities.

According to his letter, the company has expended about $4,000,000 on new and improved plant facilities in the past four years.

3. The company intends to diversify its line of products by entering the field of sale and distribution of plastic pipe.

Mr. Drastrup said that negotiations are nearing completion for A. M. Byers to market specialty plastic pipe to be produced by one of the country's largest manufacturers of plastic products.

The new president, who took office on October 1, stated that this three-point program is the result of a detailed analysis by the company's management of its capital structure, plant facilities, and market potentialities made in consultation with outside engineering firms over the past several months.

WASHINGTON DISTRIBUTOR APPOINTED BY TRABON

▲ Trabon Engineering Corp. has announced the appointment of the R. E. Kunz Co., 408 Broad St., Seattle, Wash., as its distributor covering the state of Wash. and the panhandle of Idaho.

The R. E. Kunz Co. will supervise the installation and maintenance of Trabon oil and grease systems.

ANNOUNCES APPOINTMENT OF THREE DISTRIBUTORS

▲ The Manco Manufacturing Co. of Bradley, Ill., has appointed three distributors to represent their Guillotine line of portable hydraulic tools. The Shields Manufacturing Co. of Cleve-

J&L STEEL

A PIONEER USER OF HERC-ALLOY

The original alloy steel chain

Jones & Laughlin Steel Corporation placed its first order for Herc-Alloy chain on August 10, 1934...less than a year after its introduction. J & L has been a regular customer ever since.

● Herc-Alloy is a special all-purpose chain with long-wearing properties and high resistance to impact loading.

● Herc-Alloy is sold in running lengths and in all types and sizes of sling chains assembled to customers' specifications.

CM HOISTS AND CHAIN

COLUMBUS McKINNON CHAIN CORP.

Tonawanda, New York

Regional Offices: NEW YORK • CHICAGO • CLEVELAND

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Herc-Alloy®

land, will cover the Northern Ohio area. J. R. Weiss, Jr., of Cincinnati, will represent Manco in Southern Ohio and Ky. E. M. Nash, formerly Ohio representative, will cover the greater Pittsburgh area.

SQUARE D CO. ACQUIRES IOWA NATIONAL MFG. CO.

▲ The property and facilities of the Iowa National Manufacturing Co., of Cedar Rapids, Iowa, has been acquired by Square D Co. as a wholly owned subsidiary. As a part of the transaction, Square D will take over a 26-acre site in the city's southwest section and complete a 112,000 sq ft manufacturing plant presently under construction by Iowa National.

Operations in Cedar Rapids will supplement manufacturing facilities in the company's seven U. S. plants and in Mexico City and Toronto. Square D recently announced plans for a new plant to be built in Seacaucus, N. J., and revealed a program to invest $2,500,000 in the current fiscal year in capital expansion, twice the amount expended the previous 12 months for new facilities and buildings.

HERES WHERE ECONOMY REALLY COUNTS!
LEADING STEEL MILLS USE AND RECOMMEND
BUCKEYE SILICA FIRESTONE
FOR LONGER SOAKING PIT SERVICE
What features do you require in your soaking pit linings—savings in fuel costs? . . . greater mechanical strength and rigidity? . . . low first cost and shorter installation time? . . . corrosion resistance? . . . much longer life? . . . freedom from repairs? . . . these features and many more can be enjoyed by you after you install Buckeye Silica Firestone.
Performance records prove that Buckeye is the best. Heads of masonry departments appreciate and recommend this modern refractory's money-saving installation possibilities . . . operators know how much longer service can be expected from a Buckeye-lined pit!
Steel mill executives, who have used Buckeye Silica Firestone for years, will give you many reasons for your specifying this up to date, better lining material for your soaking pits. Our service engineers will gladly work with you to obtain the finest possible results from your Buckeye installation. Ask for this service.
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REFRACTORY DEPARTMENT
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Send for free literature today!
BUCKEYE SILICA FIRESTONE
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"FOR THAT EXTRA SERVICE"
SILICA FIRESTONE

INSUL-MASTIC APPOINTS GEORGIA REPRESENTATIVE

▲ The Carter-Bearden Co. is the newly appointed representative of Insul-Mastic Corp. in the Atlanta, Ga., area. Carter-Bearden will employ Insul-Mastic's protective coatings in offering four different services to industry. These are preventing corrosion, vaporsealing insulation, waterproofing building walls, and controlling condensation.

CRANE FIRM ANNOUNCES CHANGE OF ADDRESS

▲ Industrial Crane & Hoist Corp., manufacturers of overhead cranes, jib cranes and monorail systems, on November 1 occupied new enlarged office and plant facilities at 1536 South Paulina St., Chicago, Ill.

TITANIUM PRODUCTION AT FULL CAPACITY

▲ Full capacity production of 10 tons per day of high quality titanium sponge has been achieved for the past month by the Titanium Metals Corp. of America at its Henderson, Nev., plant. It is expected that constant 10-tons-per-day operation will continue indefinitely, with the likelihood of even further quality improvements.

Titanium signed the first facilities contract for titanium sponge with the U. S. Government in July 1951. Leases were secured on major components of the $150,000,000 former Basic Magnesium, Inc. plant in Henderson, Nev., built by the government during World War II, and 151,000,000 kw hours of power allocated from nearby Hoover Dam by the Colorado River Commission. First actual production of titanium sponge came in October 1951.

Titanium Metals Corp. of America, owned jointly by National Lead Co. and Allegheny Ludlum Steel Corp., is the only producer or potential producer involved in complete recycling of all by-products, thus recapturing much of the magnesium

How HOUGHTON Helps Produce STEEL

You may know Houghton for its Hydraulic Department, where moulded packings have been made for two generations, and used by practically every steel producer. Current types include leather, synthetic rubber and the new rubber-impregnated leather (VIM 1243) that is taking industry by storm.

Or, you may know Houghton as a maker of specialty lubricants, fortifying petroleum oils and greases to do vastly improved lubrication jobs . . . open gears, hot spots, lube additives for water systems or for fuel oils . . . scores of items for hundreds of specialized applications.

And it is possible that your knowledge of Houghton has been based largely on its metal-working products: rust preventives, heat treating and quenching oils, cutting oils and bases, pickling inhibitors, hot top insulating materials, hot forging agents.

But no matter how you classify this 89-year-young Company, it is certain that Houghton products can be of aid. Behind them is a definite plus value—a field and laboratory service unequalled in our type of industry—also helpful, authoritative publications and manuals highly regarded by metal men.

Get to know Houghton better.
Write for bulletin "Houghton Serves the Steel Industry."
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PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

Hyde Park

RED CIRCLE Rolls ALLOY-CHILLED

Gray Iron Castings

Castings of any size up to 80,000 pounds. Hyde Park facilities are equal to your every requirement

Machine Castings
Lathe Beds
Housings
Pinion Housings
Mill Housings
Shoe Plates
Layout Plates
Surface Plates

Hyde Park

FOUNDRY & MACHINE CO.
Hyde Park, Westmoreland County, Pa.
ROLLS
ROLLING MILL MACHINERY
GREY IRON CASTINGS

DISCUSS LURGI MANUFACTURING DETAILS

Manufacturing details of the Lurgi iron ore sintering and pelletizing equipment are discussed by Dravo Corp. Machinery Division's E. N. Hower and F. S. McClintock (center rear) and Lurgi officials from Germany (front row, from left) H. Jurgen Reinbold, Dr. Helmut Wendeborn and Paul Speichert. Dravo will manufacture and distribute this equipment under an exclusive licensing agreement with Lurgi Gesellschaft fur Chemie und Huttenwesen, M.B.H., Frankfort, A. M., Germany. Lurgi machines process 90 per cent of the ore sintered in Germany and at the present time process more than 30 million tons of iron ore annually.

and chlorine consumed in the production of titanium sponge.

Production of titanium metal in the United States for the last year totaled 2350 tons; the new annual production rate at Henderson exceeds the combined 1952 and 1953 total output of titanium metal by all companies in the United States. In 1948 only three tons of titanium metal were produced.

Future Meetings

▲ The Annual Meeting of the American Institute of Mining and Metallurgical Engineers will be held February 14-18, 1955, at the Hilton Hotel, Chicago, Ill.

▲ The Ninth Western Metal Congress and Exposition, sponsored by the American Society for Metals, will be held March 28-April 1, 1955 at Los Angeles, Calif.

▲ The 1955 Industrial Finishing Exposition, feature of the 42nd Annual Convention of the American Electroplaters' Society, will be held June 20-23, 1955 at the Cleveland, Ohio, Public Auditorium.

"...within man's power"

Monumental achievements have marked each era of mankind. Within reach of future generations is the conquest of tuberculosis.

It is within man's power to eradicate tuberculosis—when you buy Christmas Seals to support your tuberculosis association you help to make this possible.

This year use Christmas Seals generously—and send your contribution today, please.

buy Christmas Seals

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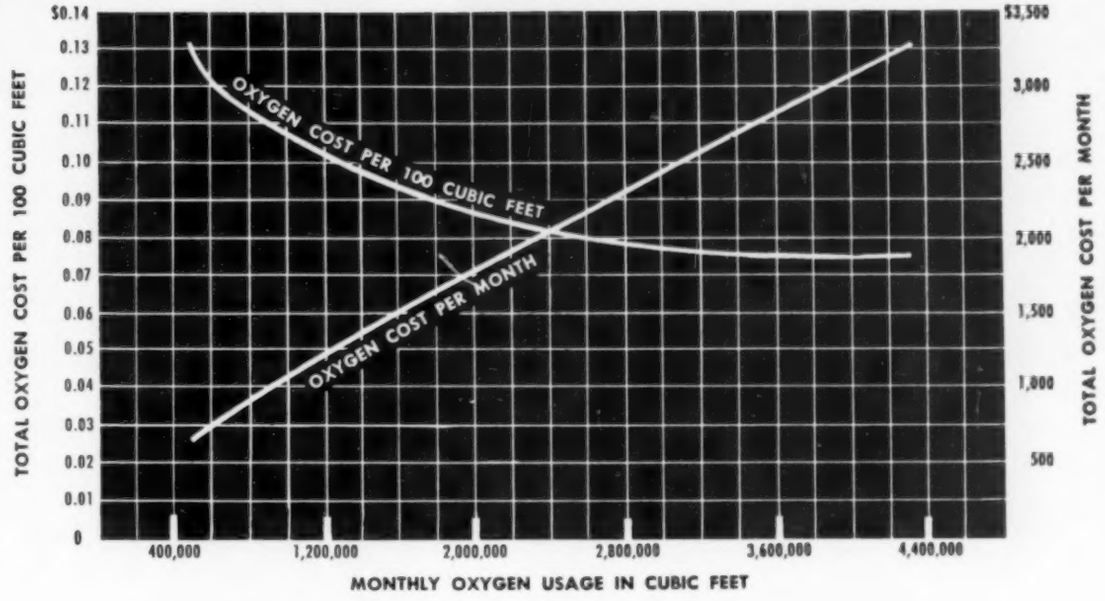
IRON AND STEEL ENGINEER

USE THE ENGINEERING MART

OXYGEN USERS: If you use between 600,000 and 4,000,000 cu. ft./month

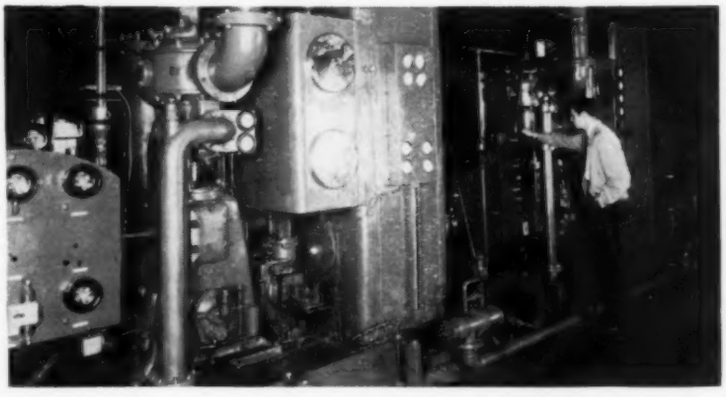
HERE'S ALL YOUR OXYGEN NEED COST* YOU!



Investigate the JOY OX-20 Oxygen Generator

CAPACITY—2000 cu. ft. per hour . . . PURITY—99.5%

The Joy principle of oxygen generation not only affords high-purity oxygen at the lowest possible cost. The unit (see twin installation pictured below) is also as reliable and easy to handle as an air compressor—and it's absolutely safe and fully automatic in operation. What's more, there are no bothersome chemicals to handle and store; no messy chemical wastes to remove. • If your oxygen usage is between 600,000 and 4,000,000 cu. ft. per month, let us give you facts and figures on a JOY oxygen generating installation to do the job for you. ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario*



***Above costs include:**

Power (at $0.01 per KWH)
Water (at $0.10 per 100 cu. ft.)
Attendance Labor (at $2.00 per hour)
Maintenance (Labor and Parts)
Amortization (Ten-year Basis)

Consult a Joy Engineer

WAD 15388

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

Superior
BLAST FURNACE COPPER CASTINGS

Cooling Plates of all kinds including Heavy Nose Super Cooled Bosh Plates
Hot Blast Valves and Valve Seats
Blast Furnace Tuyeres
Licensed Manufacturers of all Leading Designs

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8524 Vincennes Ave., Chicago 20, Ill.
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Blast Furnace Copper Castings—also Brass and Bronze Mill Castings

STRIKE!

Hannifin's New Square Type Air and Hydraulic Cylinders Are Right "Down Your Alley"!

Every Engineer will want data on these two new lines of cylinders incorporating the BIGGEST IMPROVEMENT IN CYLINDER DESIGN IN THE LAST 50 YEARS!

WRITE FOR

BULLETIN 113
Hydraulic Cylinders 2000 p.s.i.—3000 p.s.i. (non-shock)

BULLETIN 213
Fluid Power Cylinders 200 p.s.i. (air or oil)

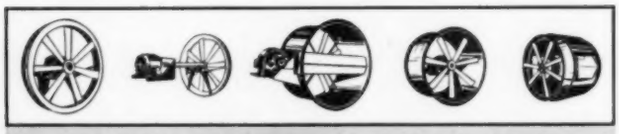
HANNIFIN

Hannifin Corporation, 577 S. Wolf Road, Des Plaines, Illinois
Air and Hydraulic Cylinders • Presses • Air Control Valves

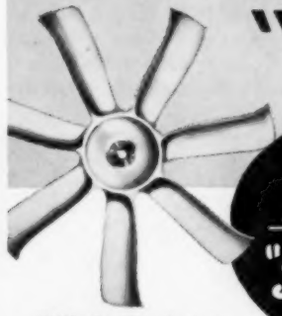
The Jones and Laughlin Steel Corporation uses four Gleason Reels for remote control on each of the two shear gauges of the PI-10" Bar Mill in their Pittsburgh Works. Two SHO-102 overhung cable reels shown on the left permit remote control of the travel motors which drive the two traverses. Two LA-76 air hose reels (one out of sight) permit remote control of the gauge stops.

Gleason makes a complete line of spring and motor driven reels in all sizes and capacities. Write for complete details.

Gleason Reel Corp.
Subsidiary of Maysteel Products, Inc.
Room 706
4076 N. Plankinton Ave. • Milwaukee 3, Wis.



performance is in the
"prop"



NEW *Aerovent* "Semi-Pressure" FANS

7-Blade "Machete" Airfoil Propeller

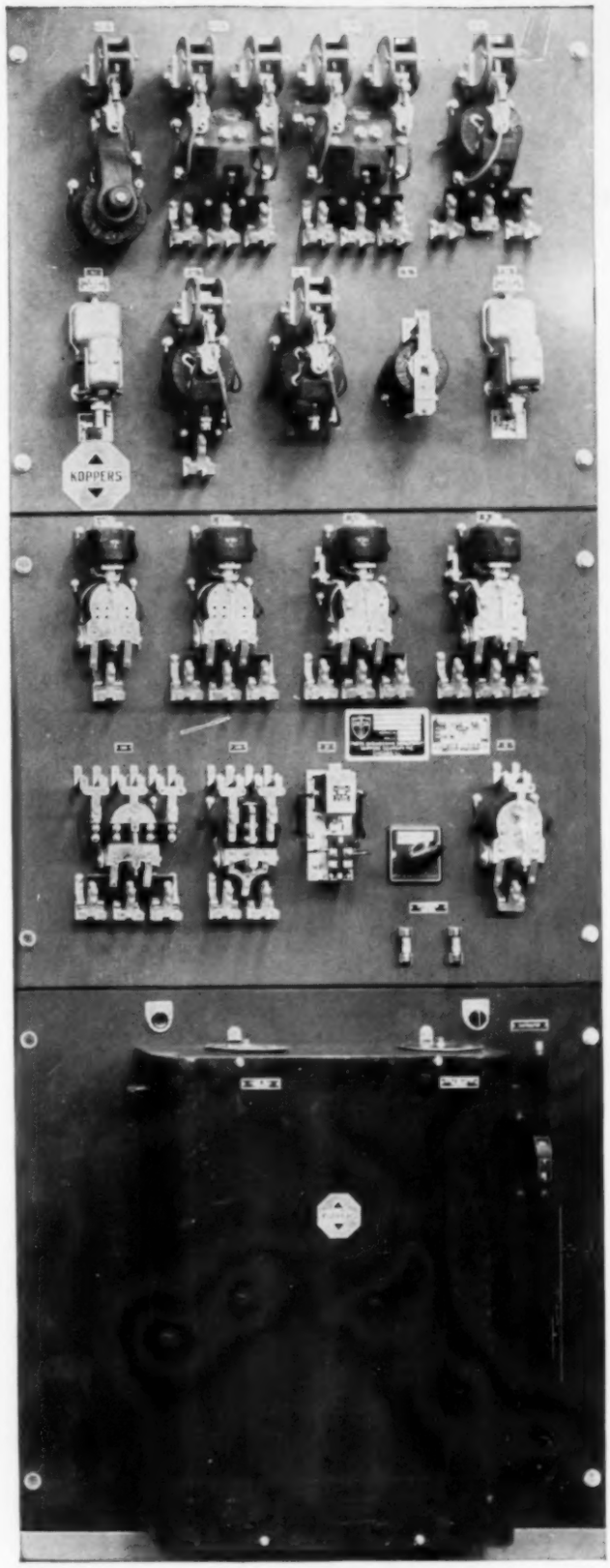
Now get top efficiency against resistances to 4½" SP *without* special equipment! Standard Aerovent units with new 7-blade propellers move more air at *slower* motor speeds with *less* horsepower. Write for folder.

Ask for bulletin S-50!

Certified Ratings

All Aerovent Fans are rated in accordance with the Standard Test Code and U.S.D.C. Comm. Std. CS178-51.

Aerovent Fan Company, Inc.
Ash and Brook Streets *Piqua, Ohio*



Freyn-Design BLAST FURNACE Reversing Distributor Control

AFFORDS THESE FEATURES:

1. Coordinated, simultaneous operation of distributor and skip hoist (patented) eliminates the distributor movement as a time factor in charging.
2. Dynamic braking affords micrometer stopping, without drift. Shoe brakes not required and not used.
3. Change of rotation angle in step with the charging round (patented) eliminates the necessity of load-counting devices.
4. Rotation angle change after a selected number of skip loads is an available option.
5. Positive interlocking forces completion of distributor rotation before small bell can be opened, safeguarding against improper charging.
6. Extreme simplicity, easily understood control, utilizing mill-type motor supplied from constant-voltage source in common with other charging equipment. Maximum reliability.
7. No speed-up required to avoid delays at higher rotation angles.
8. The recognized standard of the industry for fourteen years, incorporating the accumulated experience of 158 installations.
9. Rugged—Maintenance free—Not one Freyn-Design Distributor Control has yet been worn out or replaced.

"ASK THE MAN WHO OWNS ONE"

KOPPERS

KOPPERS COMPANY, INC.

Freyn Department

Engineering & Construction Division

KOPPERS BUILDING • PITTSBURGH 19 *Associated with* Ashmore, Benson Pease & Co. Ltd., Stockton-on-Tees, ENGLAND; De Lattre & Frouard, Paris, FRANCE

Before you buy that next machine tool
consider this...
HORIZONTAL BORING MILLS
SURFACE GRINDERS
PLANERS
VERTICAL MILLERS
ALL TYPES OF LATHES
VERTICAL BORING MILLS
RADIAL DRILLS
AUTOMATICS
CYLINDRICAL GRINDERS
TURRET LATHES
OPENSIDE MILLERS
ALL TYPES OF PRESSES
Through Engineered Rebuilding you can have any machine tool rebuilt to meet or surpass its original manufacturer's standards—and at half the cost of a new tool. The guarantee? Unconditional.
Simmons Machine Tool Corp.
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SIMMONS
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GIVES MACHINE TOOLS A NEW LEASE ON LIFE
Unconditional guarantee
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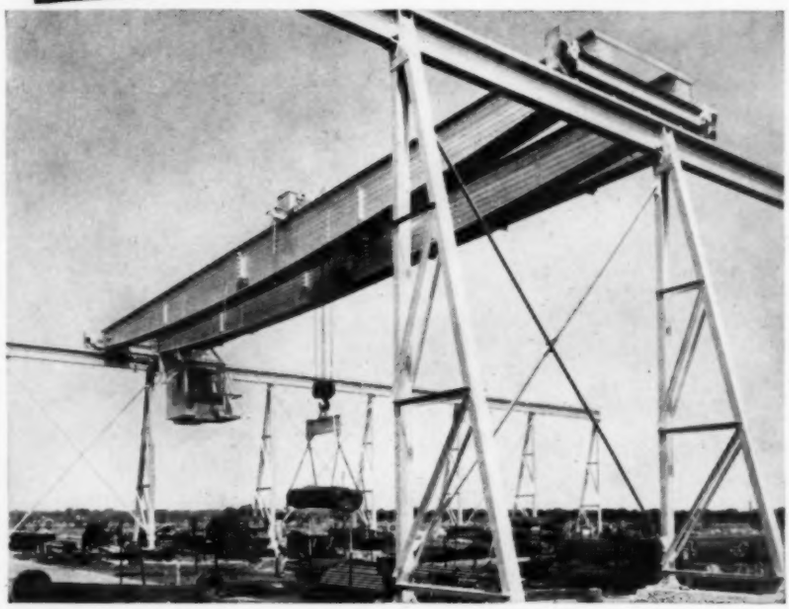
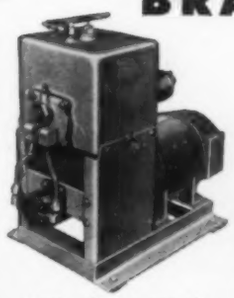
CRANE-BRIDGE BRAKES
...the choice of leaders in industry

Stop Overhead Cranes

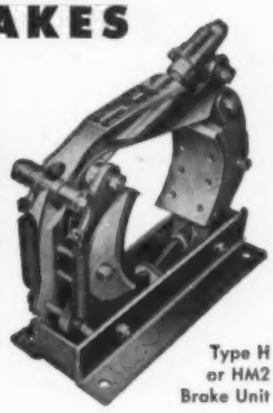
EASILY—SAFELY—WITH

Wagner Powered Hydraulic CRANE BRIDGE BRAKES





Hydraulic power unit driven by totally-enclosed motor



Type H or HM2 Brake Unit

Hydraulic braking systems for overhead traveling cranes—pioneered by Wagner—have become an industry standard.

Now, Wagner offers *Powered* Hydraulic Crane Braking for safer, more efficient operation where frequent starts and stops are necessary... where close spotting is required... where heavy equipment is involved... and for any application where exceptional ease of brake operation is desired.

Wagner Powered Braking Systems save you money because they lengthen the life of your equipment. Operators don't drag brakes and unnecessarily wear wheels and lining—cranes can be controlled without bridge motor plugging with its resultant damage to both motor and gears.

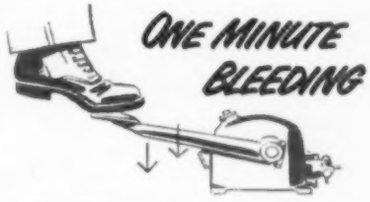
These Power Units can be added to your present Wagner Hydraulic System. Only six weeks are required to fill the average order. Bulletin IU-36 gives full details—write for your copy today.

TIP TOE BRAKING

With Wagner Powered Brakes, tons of weight can be stopped by the touch of a toe. Loads can be spotted accurately—production can be stepped up—several brakes can be operated from one pedal.

FINGER TIP PARKING

On the Wagner Type HM-2 System, a button operated spring-set brake permits safe parking, easily controlled by the crane operator. The parking brake also sets automatically, to bring the crane to a gradual stop in case of power failure.



ONE MINUTE BLEEDING

The Wagner Remote Control Bleeder permits the operator to keep the hydraulic system filled with air-free fluid for maximum efficiency. Bleeding the system is a one man job—the operator need only press a push button and pump the foot pedal several times.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6483 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

ELECTRIC MOTORS
TRANSFORMERS
INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

154-2

Jones & Laughlin

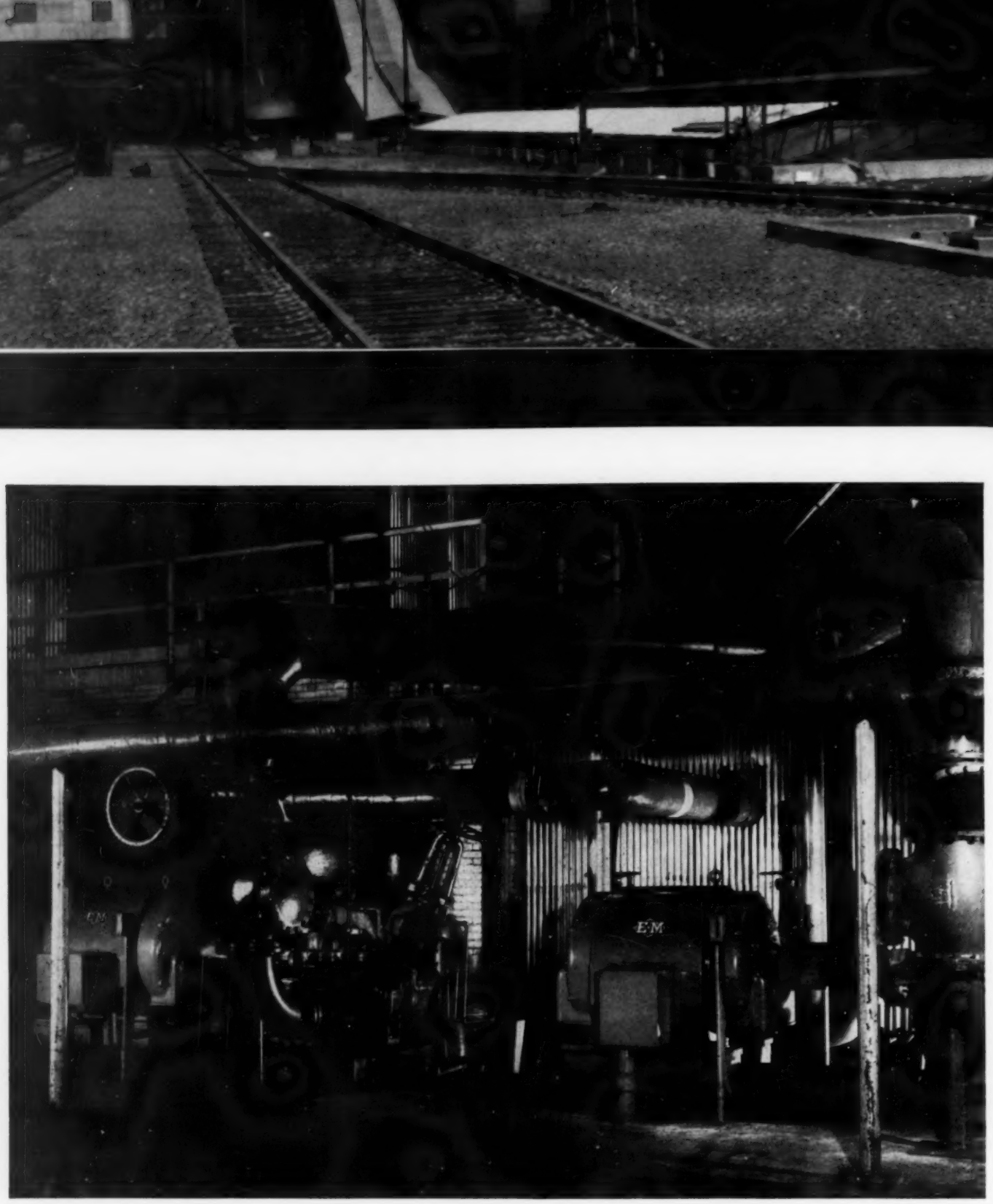
For J&L's Hazelwood Plant in Pittsburgh, Pennsylvania, Koppers engineers recently completed the construction of this new battery of 79 coke ovens. These Koppers-Becker Underjet Coke Ovens are carbonizing approximately 1,925 net tons of coal per day.

Ovens are underfired with coke-oven gas. Each individual coke oven is 40½ feet long, 13 feet high and 17 inches in average width. All ovens are equipped with Koppers Self-Sealing Doors.

In addition to designing and constructing this new coke-oven plant, Koppers engineers built related equipment such as a coke wharf, a coke-screening station, a complete flushing system, and extensive coal-handling equipment.

Koppers builds a new battery of 79 Koppers-Becker Coke Ovens

J & L's new battery of Koppers-Becker Underjet Coke Ovens. These 79 ovens are carbonizing approximately 1,925 net tons of coal per day.



Jones & Laughlin Steel Corporation enjoys low maintenance costs on large motor drives

● Safeguarding motor operation in a steel mill is an important factor in the mill's over-all profitable operation. Motor shut down means costly maintenance projects and large production losses. Bearing failures and winding burn outs are no longer considered inevitable, and today's mill operators who are interested in continuous high-level production are taking advantage of modern motor design to insure against motor failure.

The two 400 hp, 1450 rpm, splash-proof E-M Squirrel-Cage Induction Motors above show how Jones & Laughlin Steel Corporation engineers use modern motor design to protect against motor outage. These motors, which drive centrifugal pumps supplying water to three hot strip-mill furnaces at the Pittsburgh works, have given year-in, year-out service with only routine bearing lubrication and inspection. E-M *Protective Construction* keeps water and foreign material out of vital parts, so essential to uninterrupted, trouble-free operation.

And remember, *Protective Construction* means more than physical shielding of windings and bearings with splash-proof or other protective enclosures. It includes the E-M "know-how" of motor design and special attention to the smallest details of construction. Here are some of the important features in E-M *Protective Construction:*

1. Windings custom designed for the application, repeatedly processed to keep moisture out.
2. Coil ends methodically lashed to heavy rings to prevent movement during repeated starting surges.
3. Bearings precision engineered and processed for cool, long-life service.
4. And rotors of practically indestructible cage construction, accurately balanced for vibration-free operation.

For your next *special* motor application call on your local E-M sales engineer for helpful counsel. Let him show you how E-M *Protective Construction* can help keep your maintenance costs low on large motor drives. And write the factory for E-M Foto-Facts No. 16, showing other modern motor applications in a modern steel mill.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

E-M

1300-TPA-2167

Specialists in making motors do **EXACTLY WHAT YOU WANT THEM TO**

Designing and constructing coke ovens is just one way in which Koppers serves the steel industry. For any kind of metallurgical construction, you can count on Koppers.

KOPPERS

Engineering and Construction Division

KOPPERS COMPANY, INC., PITTSBURGH 19, PENNSYLVANIA

CHECKING FURNACE COMBUSTION WITH HEAT PROVER. Because it provides direct and continuous readings of oxygen and combustibles, H. Kramer & Company has found the portable Cities Service Heat Prover a great advantage in improving furnace efficiency.

"REDUCED MELTING TIME, INCREASED METAL RECOVERY WITH CITIES SERVICE HEAT PROVER!"

A Report From H. Kramer & Company:

H. Kramer & Company operates brass and bronze ingot smelting and refining plants in Chicago, Los Angeles, and Philadelphia, in addition to offices in most major cities.

Writes Foundry Metallurgist, Fred L. Riddell: "We wish to thank the Cities Service Oil Company for the Heat Prover service they have given us.

"Fuel savings have been substantial, but only incidental to the reduced melting time and considerable increase in metal recovery which afforded greater control over the quality of our product.

"In addition, use of the Heat Prover, has educated our foundry personnel to the point where they are satisfied with only the best operating conditions of all our melting units."

The portable Heat Prover, supplied and maintained free by Cities Service, can help achieve similar results for your furnace operation. For information, contact your nearest Cities Service representative or write Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

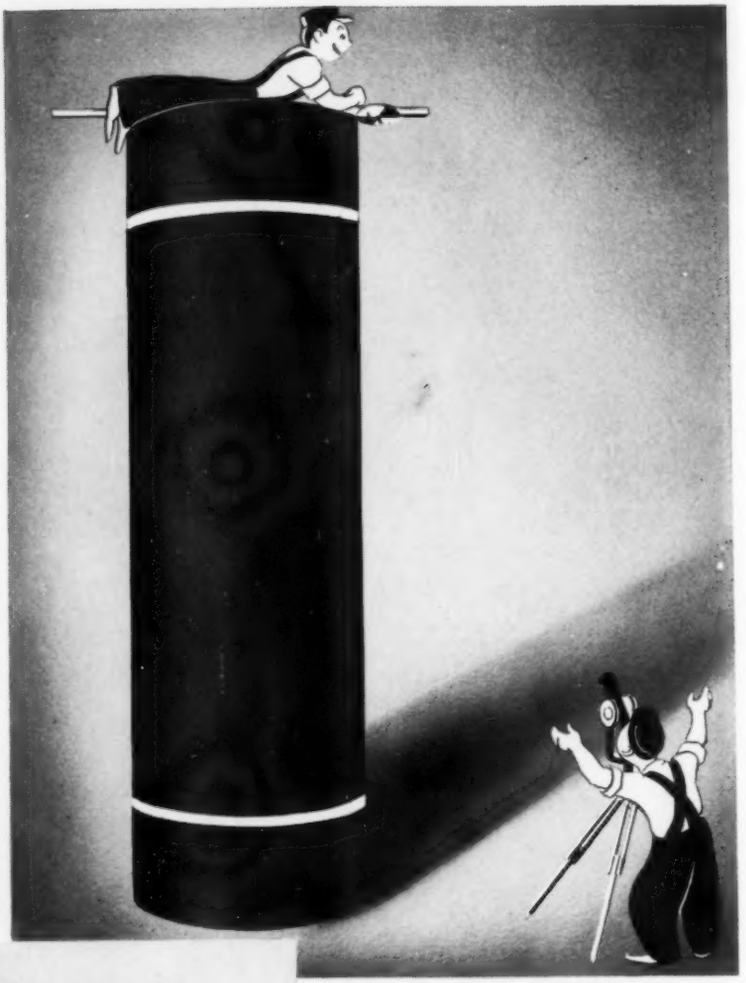
HEAT PROVER

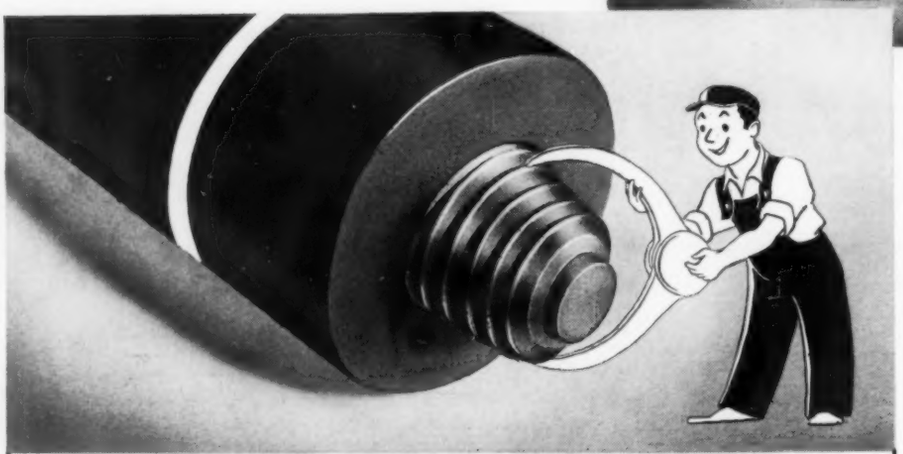
FREE—NOT AN INSTRUMENT YOU CAN BUY, BUT A SERVICE WE SUPPLY!

Want greater Electrode Savings?

Take these tips from

NATIONAL CARBON





LOOK AT NIPPLE SIZE. Electrode nipples are another potential source of economy and improved performance. For example, if you use electrodes of 16″ diameter or larger, and you are not already using the smaller nipples *pioneered by* NATIONAL CARBON COMPANY, you may be able to make this switch and save money while getting even stronger joints due to the thicker socket-walls provided by the smaller nipple sizes.

LOOK AT ELECTRODE LENGTH.

Frequently we are able to direct customers to valuable economies in cost-per-pound of electrode, as well as to other cost-saving advantages, simply by recommending a longer length than they are already using. For instance, when you switch from a 60″ electrode to one of 72″, you reduce the number of electrodes, handled and used, by *one in six,* and, even more important, you cut down the number of joints made by the same high percentage. Obviously, this increases furnace-availability and boosts production.

• These are only two of many ways that NATIONAL CARBON'S electrode technical-service facilities have helped users get the most for their electrode dollar. Let your NATIONAL CARBON representative survey your electrode and nipple requirements. He may help you get substantial savings and improved electrode performance.

FOR ELECTRODES AND ELECTRODE SERVICE...rely on NATIONAL CARBON COMPANY!

The term "National" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY

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Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

IN CANADA: Union Carbide Canada Limited, Toronto

Personnel News...

Ernest R. Johnson has been appointed vice president in charge of operations of Republic Steel Corp. He succeeds **W. M. Kelley** who has been named president of Reserve Mining Co. Mr. Johnson joined Central Steel Co., a Republic predecessor, in 1922 and worked on various mill jobs for the following three years when he joined the metallurgical staff. The following year he was made assistant superintendent of the metallurgical laboratory, and assistant chief metallurgical engineer in 1929. In 1944 he was appointed chief metallurgical engineer for Republic's Central Alloy District which consists of the Canton and Massillon steel plants. Two years later he was made assistant district manager, and in 1952 manager of Central Alloy District. In May, 1953, he was brought to Cleveland as assistant vice president in charge of operations with jurisdiction over Republic's eight basic steel plants. Mr. Johnson will be succeeded as assistant operating vice president by **Harry L. Allen, Jr.,** who has been district manager of Republic's Buffalo District, which includes a steel plant in Buffalo, and coke ovens and a blast furnace in Troy, N. Y. Mr. Allen joined Corrigan-McKinney Steel Co. in 1933 and continued with Republic after its merger with Corrigan-McKinney in 1935. With Republic he was associated with the metallurgical and inspection departments and in 1943 was made open hearth superintendent of the Cleveland plant. In 1947 he was made assistant district manager in Buffalo and in 1952 district manager.

R. L. Gray has been elected executive vice president of Armco Steel Corp. He has been president of Sheffield Steel Corp., a wholly-owned subsidiary of Armco, for many years. This company recently became the Sheffield Steel Division of Armco. He has also been a member of Armco's Board of Directors since 1940, and has been senior vice president. He was formerly associated with Valley Steel Co., Laclede Steel Co. and Kansas City Bolt and Nut Co., predecessor to Sheffield Steel. In 1925 the Sheffield Steel Corp. was organized, and Mr. Gray was elected vice president. Mr. Gray was elected president of Sheffield in 1931, which position he has held until the present time.

Charles W. Barrett has been appointed manager of Republic Steel Corp.'s Buffalo district operations. Mr. Barrett has been assistant district manager of the Buffalo district since January, 1952. He was first employed by Carnegie Steel Co. in the general engineering department and later worked for Mackintosh-Hemphill Co. on heavy rolling mill design. He was employed in a similar capacity by Pittsburgh Rolls Co. for nine years following which he went to work for Dominion Steel and Coal Corp., Sydney, Nova Scotia as superintendent of roll shops. He joined Republic Steel Corp. in 1943 and for several years was the company's chief roll engineer. Succeeding Mr. Barrett as assistant manager of the Buffalo district is **Harry H. Northrup** who has been superintendent of the open hearth department. Mr. Northrup has spent his entire business career working for Republic. Starting as a metallurgical observer, he progressed through various open hearth positions becoming superintendent of the open hearth in 1947.

Roman J. Meyer, general superintendent of the Fairfield Sheet Mill of United States Steel Corp.'s Tennessee Coal & Iron Division, has been promoted to manager of manufacturing operations for the division effective November 1. Mr. Meyer succeeds **James C. Gray,** who has been made vice president in charge of coal mines for United States Steel. Mr. Meyer joined United States Steel as a mill provider at the Gary Works, in 1921. In the ensuing years, he held a wide variety of positions at Gary Sheet & Tin Mills. When TCI's Fairfield Tin Mill was put into operation, he was transferred to that plant, as assistant superintendent of the hot strip mill. He served in that position from 1937 to 1941, before being promoted to superintendent of the strip mill. In 1948, he was made assistant superintendent of the Fairfield Sheet Mill, and three years later was promoted to the superintendency. He returned to the tin mill in 1953, to become superintendent of the plant. When the sheet mill was given separate works status, earlier this year, he was again transferred to that mill to assume the duties of general superintendent.

Norman C. Michels has been appointed to the newly established position of assistant vice president in charge of engineering for United States Steel Corp.'s Tennessee Coal & Iron Division. The appointment becomes effective December 1. Mr. Michels comes to

ERNEST R. JOHNSON

R. L. GRAY

CHARLES W. BARRETT

HARRY H. NORTHRUP

Birmingham from Pittsburgh, where he has been serving for the past three years as chief engineer — project development, with United States Steel's Engineering Division. Mr. Michels' first employment with United States Steel was as special engineer at the Carnegie-Illinois Steel Corp., Pittsburgh, in 1941. The following year, he was transferred to Carnegie-Illinois' Gary, Ind., operations, to work as an expediter. He became assistant project engineer there in 1944. In 1947 he left this position to join Laclede-Christy as a chief engineer, subsequently assuming the added responsibilities of manager of operations. He rejoined Carnegie-Illinois as a planning engineer in 1950 and worked in this capacity until he was appointed to his present position, chief engineer — project development, United States Steel Corp. in Pittsburgh on January 1, 1952.

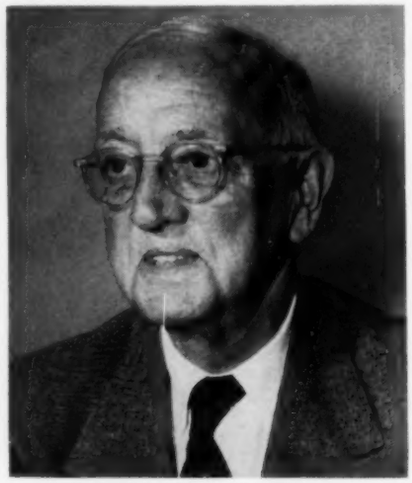
Edward Douglas Badgett was promoted from plant engineer to chief engineer of Granite City Steel Co. **Frank J. Burgert** was promoted from assistant superintendent to superintendent of the company's North Plant. Mr. Badgett will be in charge of all engineering

EDWARD DOUGLAS BADGETT

and maintenance functions for the company. Mr. Burgert will be in charge of a department with about 450 employees that handles the company's galvanizing and corrugating operations, and fabricates a number of specialty products.

Peter Robertson, formerly assistant vice president in charge of operations, Republic Steel Corp., has been appointed vice president in charge of planning and development, succeeding **E. M. Richards** who is retiring. Following announcement of Mr. Robertson's appointment, three other Republic men were called to fill positions made vacant by the promotion. **Charles P. McCabe** has been appointed assistant vice president in charge of operations — manufacturing plants; **John Dunlop** has been made manager, Bolt and Nut Division; and **Harold C. Seifert** assistant manager of the division.

Fred C. T. Daniels, vice president of research and development for Mackintosh-Hemphill Co., has retired. Mr. Daniels, who has been an active participant in the metallurgical development of the iron and steel industry throughout the past 50 years, will serve the company in a consulting and advisory capacity. He joined Mackintosh-Hemphill in 1904 as a metallurgical chemist, leaving in 1912 to join Pittsburgh Iron and Steel Foundries Co., where he was an assistant superintendent and metallurgist at its Midland, Pa. plant. From 1914



FRED C. T. DANIELS

to 1923 he was a staff metallurgist for the Wheeling Mold & Foundry Co. In 1923, Mr. Daniels became an employe of Bethlehem Steel Co., serving as superintendent of the iron roll foundry, and later was in charge of the steel roll and steel casting foundry, the No. 2 machine shop, and the No. 1 open hearth department. He returned to Mackintosh-Hemphill in 1928 and has served as a vice president of the firm for the past 26 years. During his metallurgical career Mr. Daniels played a major part in the development of high carbon alloy steel rolls, low phosphorous alloy acicular cast iron, and the Techni Process for iron and steel rolls. He holds 18 patents mostly pertaining to cast iron and cast steel rolls.

George Murray Coffey has been named manager of industrial brake sales of Wagner Electric Corp. In his

GEORGE MURRAY COFFEY

new position Mr. Coffey will coordinate the sales of industrial crane bridge brakes through the company's branch offices.

Carl J. Ricker has been appointed chief sales engineer of E. W. Bliss Co.'s Hastings Division, replacing

Newest idea in seamless tube production

Looking for improved methods of tube and pipe making?

At Mannesmann-Meer one of our most recent firsts in mill design is the three-roll arrangement being put to work in stretch reducing mills and continuous mandrel mills. The principle gives smoother outside and inside wall surfaces and better wall tolerances.

But that's only half the story. Along with the three rolls per stand, basic changes in over-all mill design include a revolutionary new mill drive and extremely fast schedule change-over. If you'd like to bring this creative engineering approach to bear on your tube mill plans or problems, why not call on us today? Mannesmann-Meer Engineering & Construction Company, 900 Line Street, Easton, Penna.

M.4.4

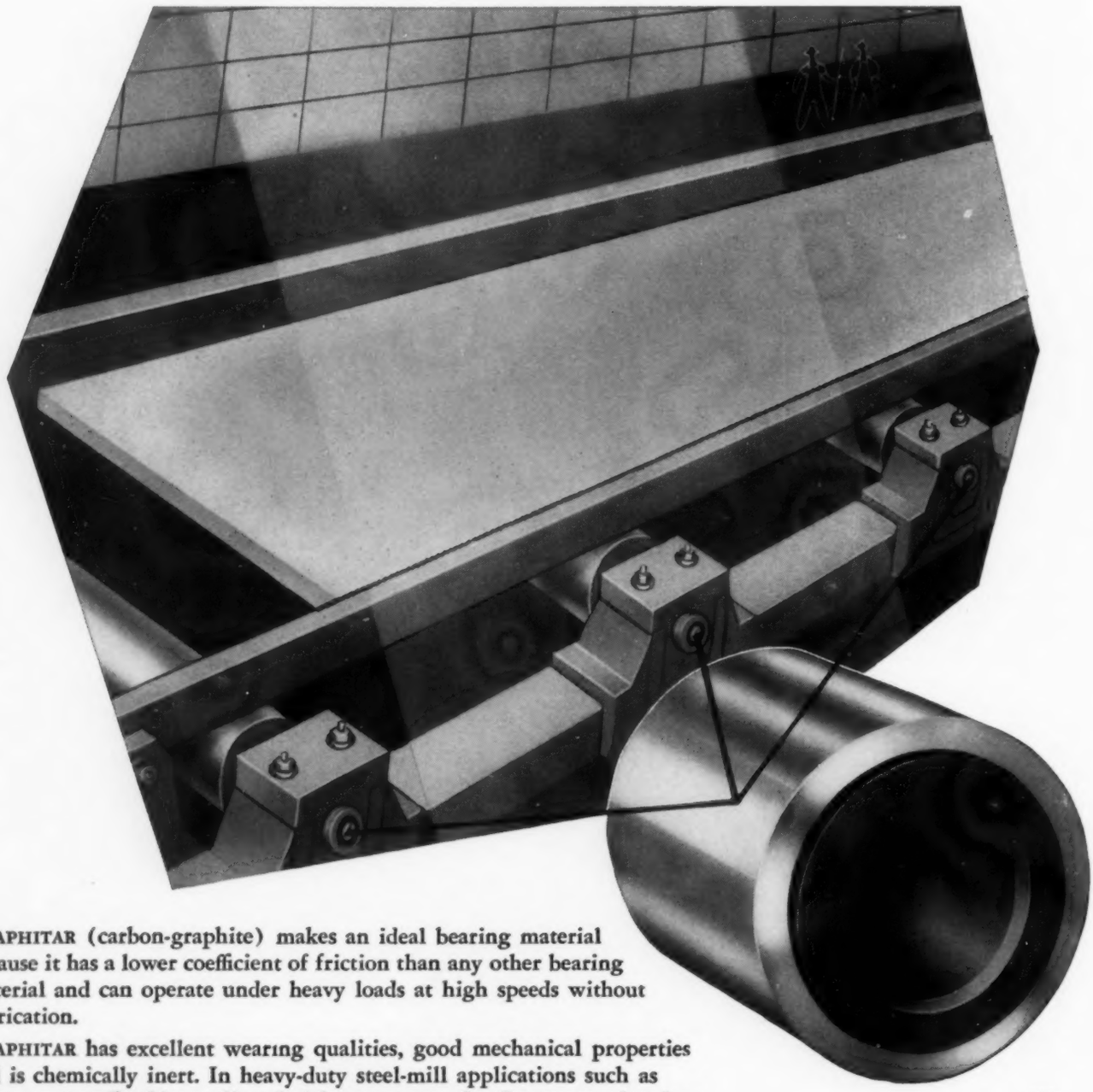
MANNESMANN-MEER

World Specialists in High-Speed Tube Mill Machinery

GRAPHITAR®

METAL-BACKED BEARINGS FOR THE STEEL INDUSTRY

Metal-backed GRAPHITAR bearings provide exceptional strength and durability for long life in difficult steel mill applications



GRAPHITAR (carbon-graphite) makes an ideal bearing material because it has a lower coefficient of friction than any other bearing material and can operate under heavy loads at high speeds without lubrication.

GRAPHITAR has excellent wearing qualities, good mechanical properties and is chemically inert. In heavy-duty steel-mill applications such as shear or cut-off tables, coil and slab conveyors, the GRAPHITAR bearings are metal-backed to provide additional strength and resistance to shock. GRAPHITAR metal-backed bearings can be supplied in tolerances as close as .0005" ready for installation.

183

OUR 100th YEAR

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

Guy Prettyman who retired recently. Mr. Ricker has been associated with Bliss for the past twenty years as head of parts sales and engineering at the Hastings plant.

L. W. Moore has been appointed superintendent of the open hearth department, Steubenville Works, Wheeling Steel Corp. **G. P. Whitaker, Jr.** was promoted to the position of general foreman of the open hearth department.

William Hagel, vice president in charge of sales of United Engineering and Foundry Co., has been ap-

WILLIAM HAGEL

pointed vice president and executive assistant. **Clark H. Johnson,** manager of machinery sales, has been elected vice president in charge of sales.

CLARK H. JOHNSON

Paul Totten, former superintendent of cold reduction at the Allenport, Pa. works of Pittsburgh Steel Co., was named assistant superintendent of the Sheet Division. **Anthony "Tony" Thomas** is the new superintendent of the hot strip mill, stepping up from general foreman. **William C. Ackerman** was appointed superintendent of cold reduction and finishing, replacing Mr. Totten. Mr. Totten joined Thomas Steel Co., now the Thomas Strip Division of Pittsburgh Steel Co., as plant metallurgist. In 1952 he was made assistant superintendent of rolling, annealing and finishing at Thomas. When Pittsburgh Steel completed its new cold rolling mill, Mr. Totten transferred to Allenport as consultant on proving in the new facilities. Mr. Thomas, joined Pittsburgh Steel in 1953 as a training supervisor on the new hot strip mill. One month later, he became roller as test runs began. In 1954, he became head roller and last July was promoted to general foreman.

Charles W. Cravens has been named second assistant district manager of Republic Steel Corp.'s Cleveland, Ohio, plant. **Kurt G. Schultz** succeeds him as open hearth superintendent, and **E. G. Kondas** replaces Mr. Schultz as assistant open hearth superintendent.

Lawrence L. Hall, formerly assistant superintendent, has been named superintendent of Republic Steel Corp.'s Warren District hot strip mills. **Harold E. Freeland** succeeds Mr. Hall as assistant superintendent.

Samuel S. Douglas has been appointed special representative to the iron and steel industry, for Joy Manufacturing Co. Mr. Douglas has been a member of

SAMUEL S. DOUGLAS

the Joy organization as a representative in the Pittsburgh District since 1948. Prior to that time he was vice president of engineering and sales at the Arms Franklin Corp.

George B. McMeans, vice president in charge of operations for the Kaiser Steel Corp., will move his offices from the company's Fontana plant to the company's executive offices in Oakland, Calif., effective January 1, 1955. He will report directly to **Jack L. Ashby,** vice president and general manager of Kaiser.

Emil J. McCauley was appointed superintendent of the 98-in. hot strip mill at the Cleveland plant of Republic Steel Corp. He succeeds **J. J. Sullivan** who has resigned. Mr. McCauley was formerly superintendent of the hot strip mill at Warren District.

Philip W. Chase was appointed assistant vice president — raw materials of United States Steel Corp. At the same time it was announced that **August J. Breitenstein** has been appointed director — exploration and planning, adding to his former responsibilities those previously held by Mr. Chase.

R. M. Miller has been appointed vice president of Stearns Magnetic, Inc. Mr. Miller joined Stearns in 1946, and was formerly manager of the company's transmission plant.

Walter F. Hinkle was elected vice president of engineering of Acme Steel Co. Mr. Hinkle will continue to direct all engineering activities for the company. He is also in charge of the company's mechanical and electrical divisions. Mr. Hinkle joined Acme Steel in 1926 as sales engineer. He later transferred to work on the design of special machinery. Then he moved to the hot mill division, first serving as assistant superintendent and later as superintendent. Mr. Hinkle was named director of engineering in 1950 and director of engineering and research in 1953.

William A. (Bill) Holt has been appointed specialist industrial heating sales, Davenport Works, Canadian General Electric Co. in Toronto, Canada. He was formerly associated with Atlas Steels Limited and the Canadian offices of the Salem Engineering and Gas Machinery Companies.

Robert B. Leggat has been promoted to director of purchases for Granite City Steel Co.

Edward J. Gesdorf has been named senior application engineer of the Farval Corp. Mr. Gesdorf has been

EDWARD J. GESDORF

Farval service manager the past year, prior to that serving since 1932 on various engineering assignments in factory and field operations.

Carleton Lord, recently associated with United States Steel in Pittsburgh as consulting engineer — materials handling, has now become employed by Talon, Inc. as project engineer — materials handling and plant layout. His present position includes all Talon plants and his main office is at Meadville, Pa. Mr. Lord recently concluded a term as Chairman of the Pittsburgh Chapter of the American Materials Handling Society. Prior to his joining United States Steel, he was engaged in materials handling activities with Corning Glass Works, Yale and Towne Manufacturing Co., and General Motors Corp.

Ralph E. Dittoe, assistant secretary of the Cleveland Worm and Gear Co., was appointed to serve also as sales manager of the company's Worm Gear Division.

RALPH E. DITTOE

Mr. Dittoe has been with the organization since 1919, serving in recent years as assistant sales manager. He is also a director of the corporation.

Eugene M. Smith was named assistant director of research for Lukens Steel Co. Mr. Smith comes to Lukens from Youngstown Sheet and Tube Co. where he was development engineer in the mill research and development department. Prior to joining Youngstown Sheet and Tube Co., he was research engineer at Battelle Memorial Institute in Columbus, Ohio.

R. R. "Bob" Williams, Jr. has been appointed manager of mines for the Colorado Fuel and Iron Corp. Mr. Williams, assistant manager of mines at Pueblo for the past year, had previously served as assistant superintendent and superintendent of the blast furnace department.

J. N. Mager was appointed manager of roll sales of United Engineering and Foundry Co. He succeeds

J. N. MAGER

Horace Mager, vice president in charge of roll sales and steel castings, who retires on December 31 after 31 years with the company.

Since 1906

Standard Boiler

Specialized

ENGINEERING . . . FABRICATION AND CONSTRUCTION SERVICE FOR ALL TYPES OF STEEL MILL FURNACES

It has been our privilege to serve many of the leading steel producers for many years.

Facilities include complete engineering, modern fabrication shops, supervisory personnel, erection crews and equipment *to serve you promptly.*

STANDARD BOILER & PLATE IRON COMPANY

ENGINEERS
FABRICATORS
ERECTORS

C. A. BRASSERT, *President*
General Offices: Union Bank Bldg.
Pittsburgh 22, Pa.
SHOPS at NILES, OHIO

Affiliated Companies:
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Call or Write **STAMCO** for...

Corrugating and Complete Line of Culvert Equipment—Slitting and Coiling Equipment for Ferrous and Non-Ferrous Material in All Capacities—Warehouse and Steel Mill Cut to Length Lines for Shearing and Levelling Sheets from Coils—Shears for Shearing Sheets and Plates Both Underdriven and Overdriven Types in all Capacities up to 1¼" plate.

STAMCO, Inc., New Bremen, Ohio

keep production up with

AIRE-RECTIFIERS

the original Split System

CRANE CAB CONDITIONER

for Crane Cabs and Pulpits

THE LINTERN CORPORATION

ROUTE 20, EAST • PAINESVILLE, OHIO

James A. Slater has been appointed sales engineer of the Rust Engineering Co. Prior to joining the Rust

JAMES A. SLATER

organization, Mr. Slater was project supervisor in the Chemical and Gas Department of the Koppers Co. He had been associated with Koppers in sales and engineering capacities since 1934.

Obituaries

H. Brooks Hatton, 68, for 37 years an employe of Mackintosh-Hemphill Co., died October 4. Mr. Hatton went to Wooster, Ohio in 1917 to manage the company's plant in that city. For the last 25 years he was a

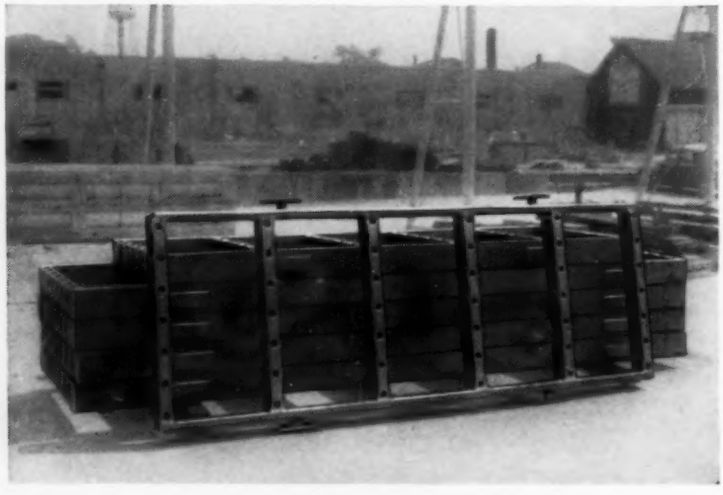
WELDCO Pickling Crates

With the New Pierced-

Type Cross Members

Offer Bigger Payloads—

Longer Service Life



• These six Weldco pickling crates, made of Monel, are now in use in a Gary, Indiana, sheet mill. Sturdy and long-lasting, they're pickling sheet steel in a 5 to 10% sulphuric acid bath at 160° to 180° F. An extra feature of these Monel crates is the new, pierced-type cross member, with these cost-cutting advantages:

1. Greater strength—more tonnage per load.
2. Less hole distortion or enlargement. The taper pins remain tight—do not become loose or wobble.
3. Less time needed for loading, as less time required for placing pins, due to tapered hole.
4. Only a small surface is exposed to attack by acid. Cross member retains its strength longer, and there are fewer replacements.

Why not find out how these long-lasting Weldco crates can improve your pickling operations? Write or phone today for complete details and descriptive literature.

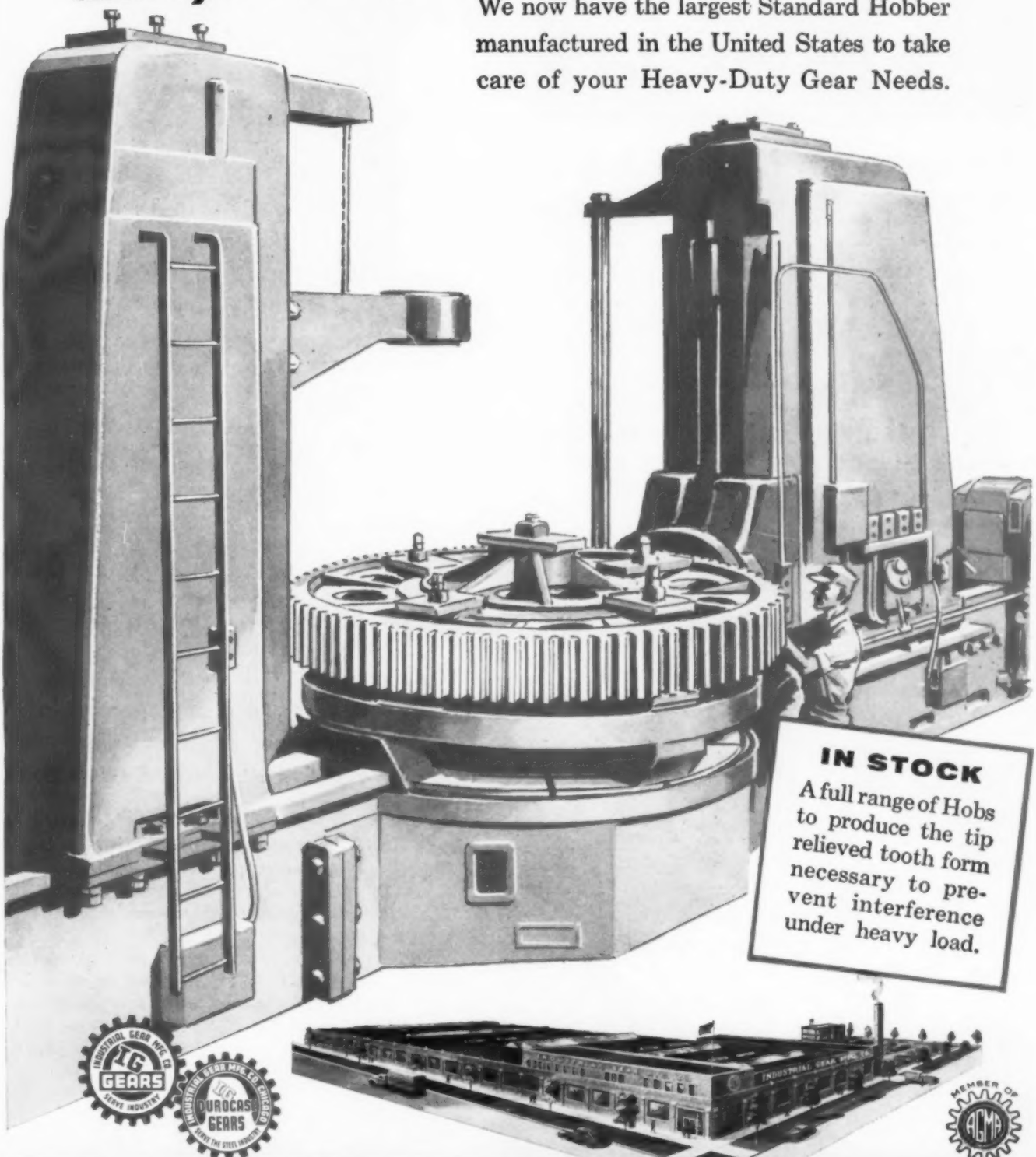
THE YOUNGSTOWN WELDING & ENGINEERING COMPANY

3762 OAKWOOD AVENUE • • • YOUNGSTOWN 9, OHIO

Industrial Gear

always a step ahead with the latest

We now have the largest Standard Hobber manufactured in the United States to take care of your Heavy-Duty Gear Needs.



IN STOCK

A full range of Hobs to produce the tip relieved tooth form necessary to prevent interference under heavy load.

IG GEARS — INDUSTRIAL GEAR MFG. CO. — SERVE INDUSTRY

DUROCAST GEARS — INDUSTRIAL GEAR MFG. CO. CHICAGO — SERVE THE STEEL INDUSTRY

MEMBER OF AGMA

Industrial Gear Mfg. Co.

4527 W. VAN BUREN ST.
CHICAGO 24, ILLINOIS

the oval-cover, flat-back Pylet

The new "OR" series Pylets with interchangeable features will meet all your conduit fitting requirements for ***machinery wiring . . . plant maintenance . . . and new construction.***

- Accurate, ferrous alloy castings.
- Tapered, machine cut threads.
- Large, flat back area, easily drilled for secure mounting.
- Roomy, smooth interior facilitates wire pulling.
- Well-rounded edges prevent wire damage.
- Self-retaining cover screws.

Sold only through authorized distributors.

SINCE 1897

THE PYLE-NATIONAL COMPANY
1383 North Kostner Avenue, Chicago 51, Illinois

CONDUIT FITTINGS • PLUGS AND RECEPTACLES • LIGHTING FIXTURES

Mackintosh-Hemphill sales engineer covering the Youngstown, Chicago and Cleveland areas.

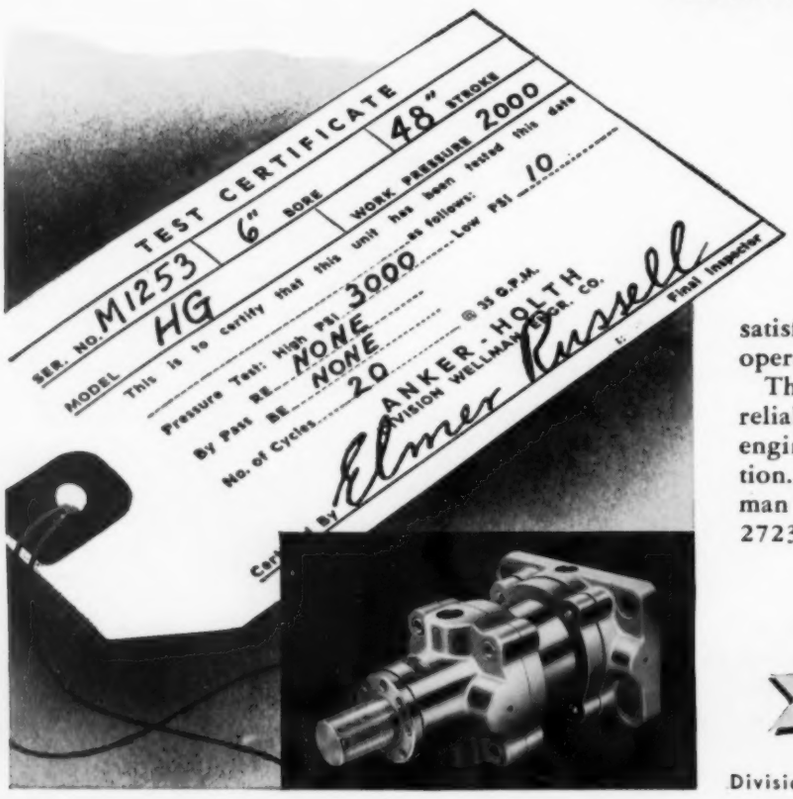
Gilbert Haller Turner, director of industrial relations for the Timken Roller Bearing Co., died October 9. He was 48. Mr. Turner had been with Timken for

GILBERT HALLER TURNER

26 years. He had handled the firm's labor negotiations for more than a decade, being supervisor of labor relations for five years before assuming the industrial relations post.

Harry E. McMinn, 62, director, secretary, and chief engineer of Guibert Steel Co., died October 21. He had been associated with the company for 30 years.

Every Anker-Holth Cylinder is certified at 1½ times working pressure


TEST CERTIFICATE
SER. NO. M1253
6" BORE
48" STROKE
MODEL HG
WORK PRESSURE 2000
This is to certify that this unit has been tested this date as follows:
Pressure Test: High PSI 3000 Low PSI 10
By Pass BE NONE
No. of Cycles 20
ANKER-HOLTH DIVISION WELLMAN ENGR. CO.
Final Inspector
Elmer Russell

This safeguard of dependable performance is yours when you SPECIFY ANKER-HOLTH CYLINDERS

● Each Anker-Holth Cylinder is tested at 150% of working pressure with the latest completely-filtered testing equipment. A tag such as shown at left certifies to its satisfactory performance under these above-normal operating conditions.

This is another reason why it pays to specify reliable Anker-Holth Cylinders. Call or write for engineering help on your problems in power motion. ANKER-HOLTH DIVISION of The Wellman Engineering Company, Department E-12, 2723 Conner Street, Port Huron, Michigan.

Anker-Holth
ENGINEERED CYLINDER POWER
WELLMAN

Division of THE WELLMAN ENGINEERING COMPANY

Wellman will build it

Gas Producer Plants
Special Cranes
Coke Pushers
Ore Bridges
Charging Machines
Forging Manipulators
Gas Flue Systems
Gas Reversing Valves
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Skip Hoists
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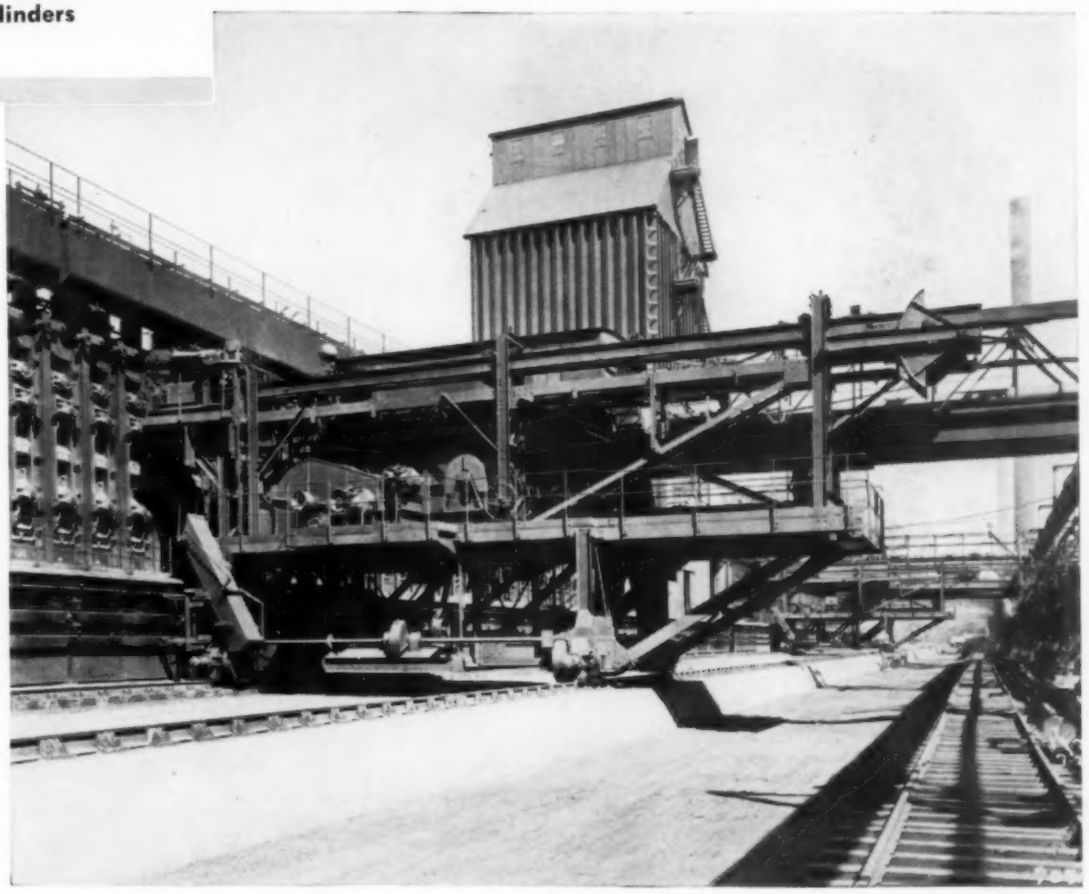
Power Cylinders

Wellman coke pushers

...engineered for economical, trouble-free performance



Wellman Combined Coke Pusher, Coal Leveler and Door Extractor in operation at Bethlehem Steel's Lackawanna Plant.

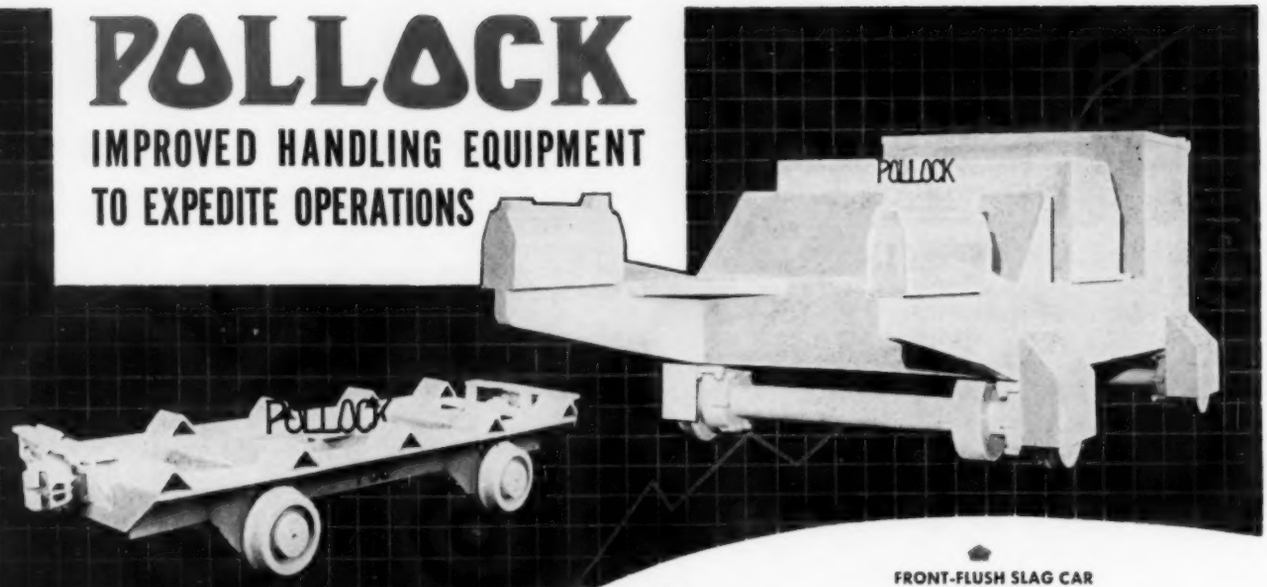
● Many of the world's most modern byproduct coke oven plants are Wellman equipped. The Wellman Engineering Company's more than half-century experience in building heavy machinery guarantees sound design and expert construction. Wellman equipment provides peak economy, maximum safety and trouble-free performance under a wide variety of operating conditions.

THE WELLMAN ENGINEERING COMPANY

7010 CENTRAL AVENUE • CLEVELAND 4, OHIO

POLLOCK

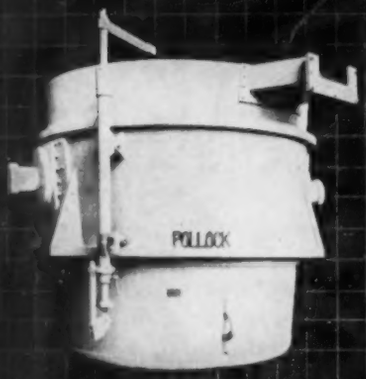
IMPROVED HANDLING EQUIPMENT TO EXPEDITE OPERATIONS



FRONT-FLUSH SLAG CAR

CHARGING BOX CAR

INGOT CAR



OPEN HEARTH LADLE

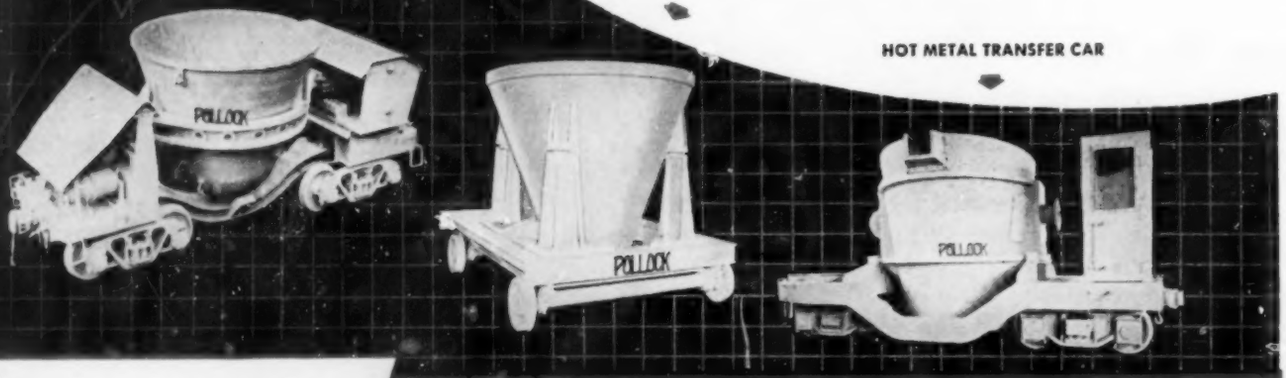
SLAG CAR

an important factor in increased open hearth production

• Pollock experience in the development and construction of open hearth equipment assures smooth flow of operations. To measure use-value of Pollock handling equipment, add their day by day engineering research to 85 years of producing for the steel industry. General specifications available on request. Special-performance details engineered for your needs.

DRAG-OUT SLAG CAR

HOT METAL TRANSFER CAR



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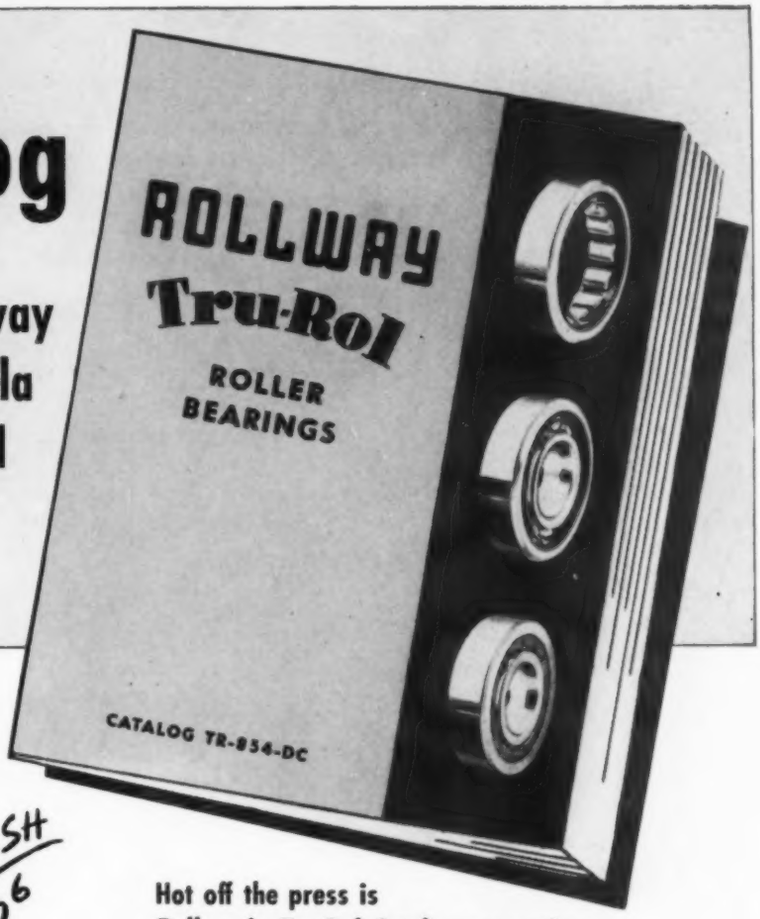
STEEL PLATE CONSTRUCTION · ENGINEERS · FABRICATORS · ERECTORS

BLAST FURNACES · HOT METAL CARS AND LADLES · CINDER AND SLAG CARS · INGOT MOULD CARS · CHARGING BOX CARS · WELDED OPEN HEARTH LADLES

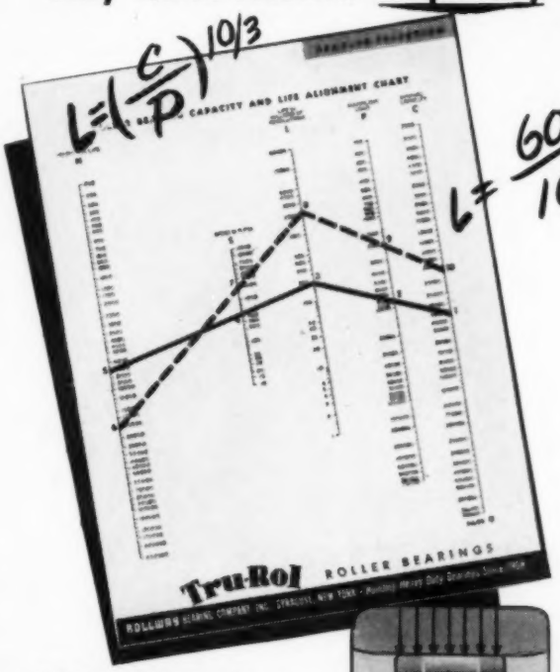
New Catalog

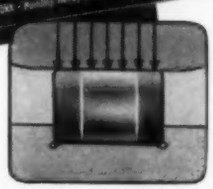
FEATURING

An accurate, simplified way to apply the RBEC* formula when selecting cylindrical Roller Bearings



Easy Quick Solution Graphically





All Tru-Rol Bearings Now Have *Crowned* Rollers

Crowned Roller under full load — stress uniformly distributed.

*Roller Bearing Engineers' Comm.—Anti-Friction Bearing Mfrs. Assn.

Hot off the press is Rollway's Tru-Rol Catalog presenting...

New Rollway Alignment Chart

Now, for the first time, RBEC* formula is converted into simple nomogram! Complicated selection procedure eliminated! Using this graphic method, simply draw two lines—and find in a matter of *seconds* the proper bearing for your application.

Complete Description, Ratings, Dimensions

All the data you require on every size and type of Tru-Rol Roller Bearings. And here is introduced the new, exclusive quality mark in the Tru-Rol field—*Crowned* Rollers! Crowning eliminates end loading, produces uniform stress pattern along full length of roller, and extends bearing life.

SEND FOR YOUR FREE COPY

Included with Rollway's new 36-page catalog are extra copies of the new Alignment Chart. Mail coupon for yours today!

ROLLWAY BEARING CO., INC.
Syracuse 4, N.Y.

Please send free copy of your new Tru-Rol Catalog with extra Alignment Charts.

Name..... Title.....

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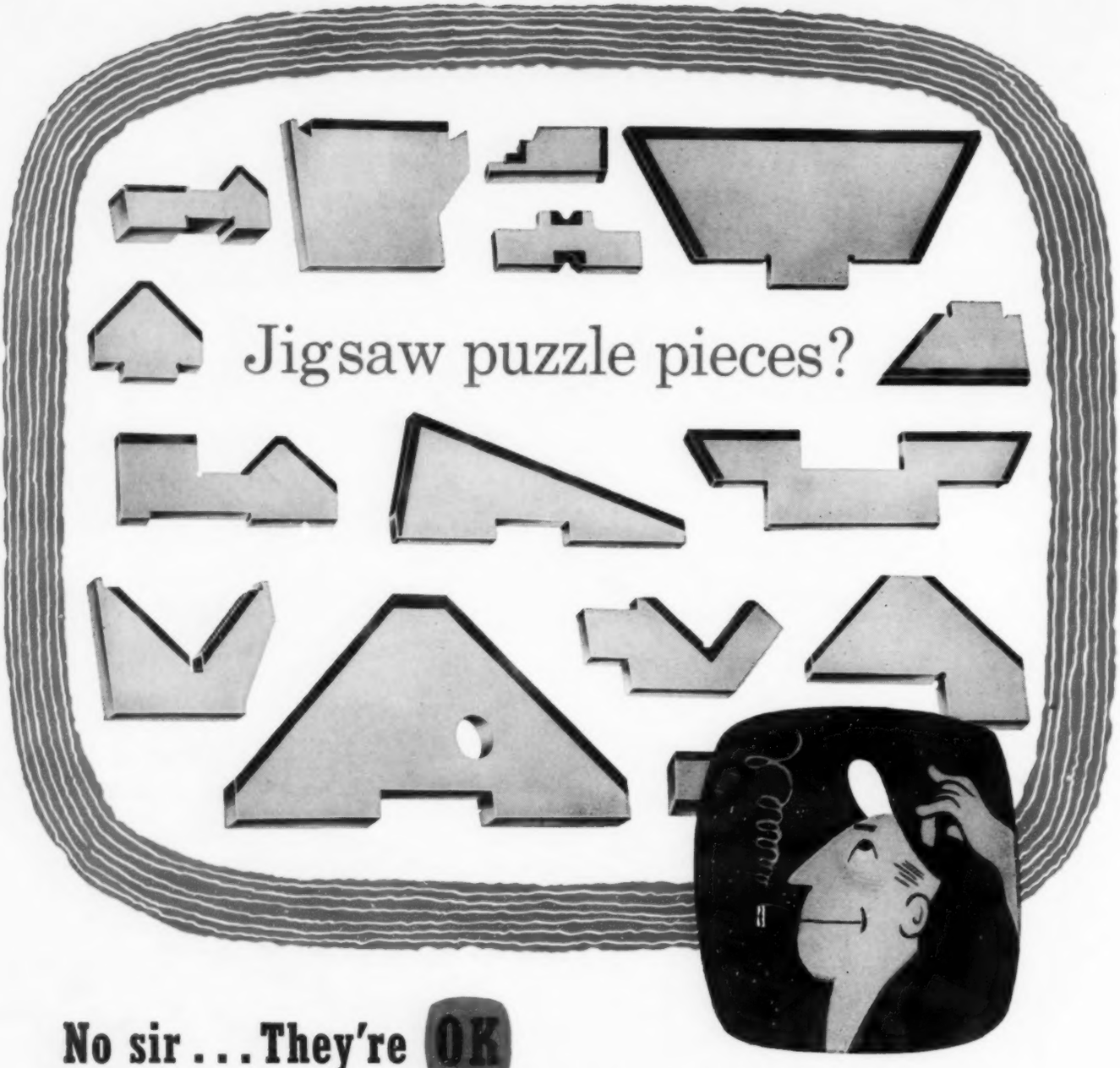
ROLLWAY BEARINGS

COMPLETE LINE OF RADIAL AND THRUST CYLINDRICAL ROLLER BEARINGS

SALES OFFICES: Syracuse • Boston • Chicago • Detroit • Toronto • Pittsburgh • Cleveland • Milwaukee • Seattle • Houston • Philadelphia • Los Angeles • San Francisco



No sir . . . They're OK hardened bedway cross sections!

These hardened ways, made by The Ohio Knife Co., give you an idea of the diversified shapes and sizes supplied. OK's special process of manufacture permits building to your specifications in a wide range of design.

Specially heat-treated tool steel makes OK ways practically wear-proof and helps maintain constant accuracy throughout the life of the machine. This extreme hardness, 65-66 Rockwell "C," is uniform to 3/16-inch depth or more.

Through the Ohio Knife process the long-wearing tool steel is welded to a soft steel backing under 2500 tons pressure. Then precision equipment finishes the bedway by grinding to tolerances up to ± .0002 inches

THE OHIO KNIFE CO.

CINCINNATI 23, OHIO

Write today to Dept. 17-Z for comprehensive bulletin, or send us your bedway specifications.

Manufacturers for the metalworking industry of:

SLITTER KNIVES • SHEAR BLADES • BRONZE WAYS
ROTARY SHEAR KNIVES • HARDENED SPACERS
HARDENED WAYS • BALL RACES
WEAR STRIPS • GIBS

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NOVEMBER, 1954

You Can Obtain...

... any of the bulletins reviewed in the Publication Service of the IRON AND STEEL ENGINEER without obligation or cost. Simply circle the desired item numbers on one of the prepaid postal cards and mail. The requests will be forwarded to the manufacturers involved who will send the bulletins to you.

Note: Post cards expire three months after publication date.

(1) Roller Bearings

A new catalog fully describes the Tru-Rol line of cylindrical roller bearings, manufactured by Rollway Bearing Co. It lists types, sizes, dimensions and load ratings; details their "crowned" rollers — a feature that relieves high stress areas at the roller ends; and includes a formula for load ratings as well as a method of calculating expected bearing life, based on the formula of the Roller Bearing Engineers' Committee, Anti-Friction Bearing Manufacturers' Association. (TR-854-DC).

(2) Maintenance

Johns-Manville has just issued an illustrated 12-page brochure containing 101 suggestions for maintaining plant buildings and equipment. It contains the latest recommendations for getting the best service out of insulations, packings, refractory products, roofings and friction materials.

(3) Splicers

E. W. Bliss Co. has just issued a bulletin which describes their complete line of Weld-A-Matic Splicers. The brochure illustrates and describes typical ferrous and nonferrous mill installations of the splicer for continuous strip splicing lines and in building up coils to larger sizes. Other applications are also listed. In addition, a schematic diagram illustrates the unique operating principle of the splicer. (Bulletin 43).

(4) Refractories

The Ramtite Co. announces a new bulletin on the use of castable and gunning refractories in steel mill furnace construction and repair. This leaflet illustrates by word and picture several economical, convenient ways of constructing, maintaining and repairing heating furnaces. (Bulletin A-23-54)

(5) Crane Controls

A unique new booklet of 20 pages has just been produced by Harnischfeger Corp. covering all aspects of the P&H Magnetorque crane control. The bulletin also carries a quick review of all types of crane controls and reproduces a picture of the first P&H electric three-motor crane built. An unusual feature of the booklet is the transparent "flip-over" page at the back of the book which reproduces speed-load curves of Magnetorque. The reader can make a quick visual comparison of Magnetorque with all other types of AC controls by merely flipping this transparent chart over the charts on the regular printed pages. (Bulletin C-50).

(6) Combustible Gas Analyzers and Alarms

Mine Safety Appliances Co.'s complete line of combustible gas analyzers and alarms are described in a 20-page brochure. Prepared to give details of how these instruments work, the brochure contains part-by-part descriptions of the components of MSA's analyzers. Actual installations in varied industries are fully covered, and a method of designing a combustible gas alarm system is shown schematically. Instruments to protect against most of the known combustible gases and vapors are described. (0703-3).

(7) Hot Metal Cars

Available from M. H. Treadwell Co., Inc. is their latest catalog illustrating mixer-type hot metal cars. The booklet discusses the economies and improvements in practice obtainable with the Treadwell car as compared with open-top hot-metal cars. (Bulletin No. 60).

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IRON & STEEL ENGINEER
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PITTSBURGH 22, PA.

IRON & STEEL ENGINEER

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ITEM	COMPANY	BULLETIN	DESCRIPTION
50	ADALET MANUFACTURING CO.	BULLETIN E.	Vapor-tight fixtures.
51	AEROVENT FAN CO.	BULLETIN S-50.	New Semi-pressure fans.
52	AMERICAN FLEXIBLE COUPLING CO.	CATALOG 501 AND BULLETIN 1052.	Fully crowned tooth form couplings.
53	AMERICAN WHEELABRATOR & EQUIPMENT CORP.	BULLETIN 894.	How to descale steel strip at high speeds and low cost.
54	ASKANIA REGULATOR CO.	BULLETINS 161, 139.	Edge position controls.
55	BEDFORD FOUNDRY & MACHINE CO., INC.		Crane catalog.
56	E. W. BLISS CO.	CATALOG 40-A.	New 60-page rolling mill brochure.
57	BRISTOL CO.	P1245.	Modern Potentiometer pyrometers.
58	BROOKS OIL CO.		Bulletin on Leadolene 375, industrial lubricant.
59	BUSSMANN MANUFACTURING CO.	BULLETINS FIS, HCS.	Dual-element and Buss Hi-Cap fuses.
60	CLARK CONTROLLER CO.		Control centers by Clark.
61	CLARK EQUIPMENT CO.		Details on Y-200, new 20,000-lb truck.
62	CLEVELAND QUARRIES CO.		Silica firestone.
63	CRANE CO.		Diaphragm valves.
64	DRAVO CORP.	BULLETIN 1503.	Description of new line of Lurgi designed equipment for treating ore and concentrates.
65	DURABLA MANUFACTURING CO.	BULLETIN P-1.	Check valves for tanks and other vessels.
66	ELECTRIC CONTROLLER & MANUFACTURING CO.	BULLETINS 921-SK, 1032.	Crane controls and safety limit stops.
67	ELECTRIC MACHINERY MANUFACTURING CO.	FOTO-FACTS NO. 16.	Modern motor applications in a modern steel mill.
68	ELECTRIC SERVICE MANUFACTURING CO.		Complete catalog on insulators, collectors and rail shoes.
69	FALK CORP.	BULLETIN 3104.	All-steel motoreducers.
70	FARVAL CORP.	BULLETIN 26.	Industrial lubrication systems.
71	D. B. FLOWER MANUFACTURING CO.	CATALOG 41.	Precision engineered brush holder catalog.
72	FULLER CO.	BULLETIN C-5A.	Rotary compressors.
73	GENERAL ELECTRIC CO.	BULLETIN GEA-4654C.	DC armored motors.
74	HANNIFIN CORP.	BULLETINS 113, 213.	Hydraulic and fluid power cylinders.
75	E. F. HOUGHTON & CO.		Houghton serves the steel industry.
76	C. B. HUNT & SON, INC.	BULLETIN 531.	Control valves.
77	IDEAL INDUSTRIES, INC.		Handbook on commutator and slip ring maintenance.
78	JOHNS-MANVILLE SALES CORP.	BROCHURE IN-134A.	Block insulation.
79	LINK-BELT CO.	BOOK 2274.	Complete variable speed drive line.
80	MINNEAPOLIS-HONEYWELL REGULATOR CO.	DATA SHEETS 10.18-3, 10.18-2, 10.18-1a.	Automatic electric weighing systems.
81	MORGAN ENGINEERING CO.	BOOKLET A-7.	Equipment for heavy service.
82	MORGARDSHAMMAR.	BULLETIN L3-1E.	Roller guides for bar and wire rod mills.
83	NAGLE PUMPS, INC.	CATALOG 5206.	Horizontal and vertical shaft pumps.
84	OHIO ELECTRIC MANUFACTURING CO.	CATALOG 113.	New self-contained, battery operated magnetic lift.
85	OHIO KNIFE CO.		Hardened bedway cross sections.
86	PENNSYLVANIA TRANSFORMER CO.	BULLETIN 309.	Transformers for the steel industry.
87	PITTSBURGH LECTROMELT FURNACE CORP.	BULLETIN 9.	Melting furnaces and components.
88	POST-GLOVER ELECTRIC CO.		Steel grid resistors.
89	RADIO CORP. OF AMERICA.		Industrial television.
90	RUST-OLEUM CORP.		Rust preventive literature and color chart.
91	SPRAYING SYSTEMS CO.	DATA SHEET 6120.	Industrial spray nozzles.
92	S. G. TAYLOR CHAIN CO.	BULLETIN 90.	Alloy steel sling and grab hooks.
93	M. H. TREADWELL CO., INC.	BULLETIN 60.	Mixer-type hot metal cars.
94	UNION CARBIDE AND CHEMICAL CORP., NATIONAL CARBON CO.		Brush maintenance literature.
95	UNITED STATES GRAPHITE CO.		Brush catalog.
96	WAGNER ELECTRIC CORP.	BULLETIN IU-36.	Powered hydraulic crane bridge brakes.
97	JOHN WALDRON CORP.	BULLETIN 55C.	Coupling information.
98	JERVIS B. WEBB CO.		Conveyor catalog.
99	L. J. WING MANUFACTURING CO.	BULLETIN DH-1.	Door heaters.
100	YODER CO.		Slitter book.

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1011 EMPIRE BUILDING
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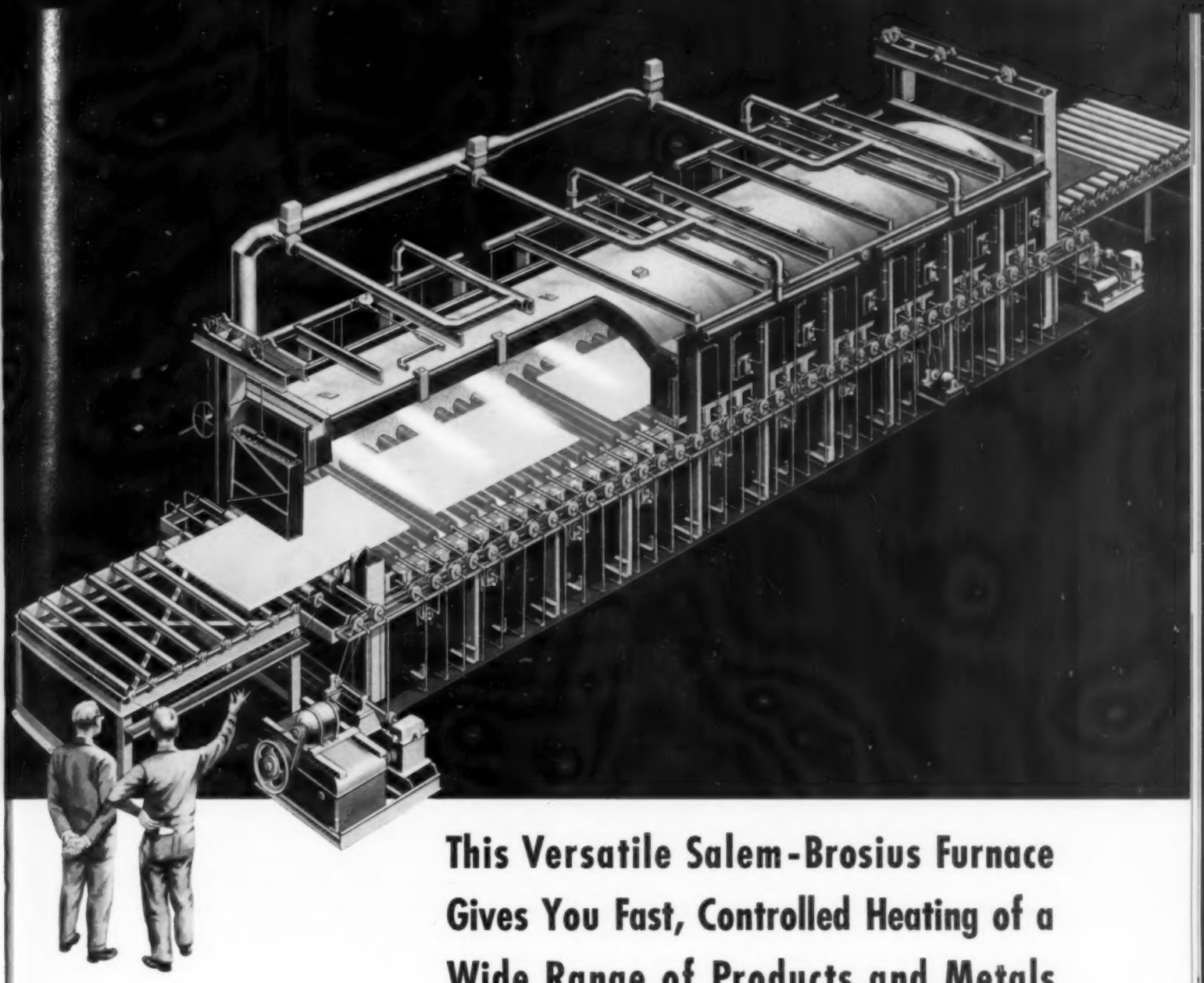


This Versatile Salem-Brosius Furnace Gives You Fast, Controlled Heating of a Wide Range of Products and Metals

This roller hearth furnace, designed by Salem-Brosius, gives you fast, automatic control of heating for a variety of shapes and types of metals.

High temperature non-ferrous alloys, steel, brass and aluminum in slabs, sheets, packs, flat bars—even trays of small parts—are heated in this type furnace. This installation heats high temperature alloy sheets to 2250°F at rates up to 7500 pounds per hour. Typical sizes of slabs and packs heated in this 38-foot furnace will range from 40 x 71 inches to 58 x 95 inches.

Heating is precisely controlled to within extremely narrow limits through three zones by automatic indicating-recording pyrometers and thermocouples.

The material moves through the furnace on a roller hearth which consists of a series of Hastelloy water-cooled rolls. This furnace has operated for more than 3800 hrs. without roll replacement—an outstanding achievement for such furnaces. Sound design and top-quality materials and components, such as efficient burners and devices for close control of operating temperatures are your assurance of long, trouble-free, economical operation.

As a leader in the field of designing, fabricating and installing precise heating and heat-treating furnaces, Salem-Brosius recently augmented its technical skills by the acquisition of the George J. Hagan Company—now offers you the combined special talents of both organizations in solving your heating problems. To learn how you may improve your heating practice, and increase production with economy, ask to have an engineer call. He will be glad to study your problem and submit a recommendation.

SALEM-BROSIUS, INC.

EXECUTIVE OFFICES: 248 FOURTH AVENUE, PITTSBURGH 22, PA.

"...business helps itself by promoting thrift among its own people."

EDWARD C. BALTZ
President
Perpetual Building Association
Washington, D. C.

"Expanding the regular sales of U. S. Savings Bonds is essential to the continued success of our Government's sound money policy. Savings Bonds help people build security for themselves and stability for the nation's economy. A reserve in Bonds gives them the assurance to spend current income on homes, cars and other substantial purchases. Meanwhile, regular Bond buying goes on adding to their future buying power. Thus business helps itself by promoting thrift among its own people. The surest way to encourage an employee to save regularly right where he works is to sign him up on the Payroll Savings Plan."

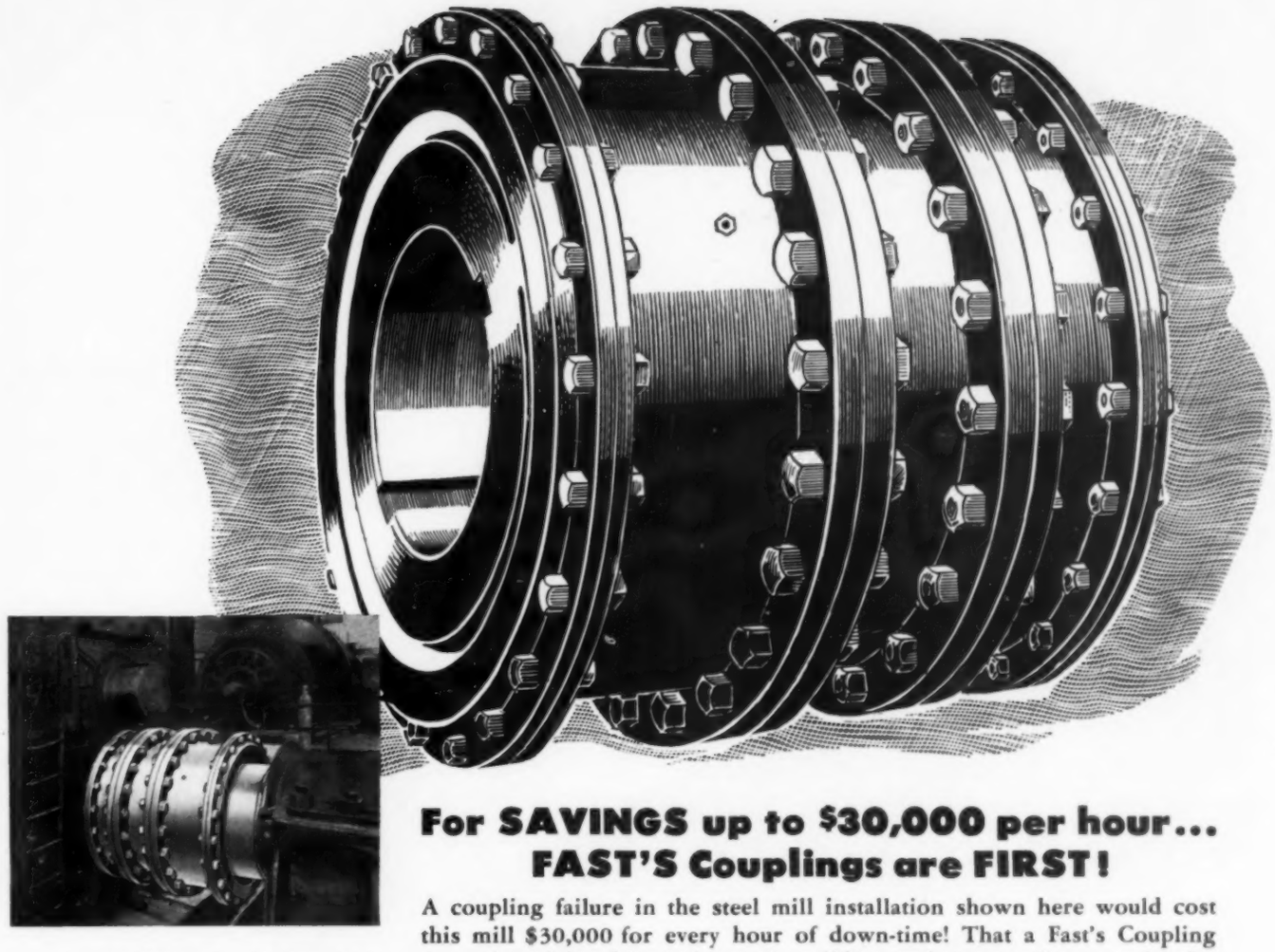
Let's point up this statement by Mr. Baltz, head of one of the nation's outstanding thrift institutions and volunteer chairman of the District of Columbia Savings Bond Committee, with a few facts and figures:

- currently, more than 45,000 companies, large and small, representing every classification of industry and business, are encouraging national thrift through the Payroll Savings Plan.
- every month, 8,500,000 Payroll Savers in these 45,000 companies invest more than $160,000,000 in Savings Bonds.
- largely as the result of employer-encouraged thrift the cash value of Savings Bonds held by individuals on July 31, 1954, totaled more than 37.5 billion dollars.
- never before has America had such a reserve of future purchasing power.
- invested in America, these 37.5 billion dollars in Savings Bonds Dollars are a most effective check on inflation and a very important contribution to economic stability and a sound dollar.

A million new Payroll Savers by the end of 1954! That's the goal of those who believe that what is good for Americans is good for business. To do your part in reaching this objective, phone, wire or write today to Savings Bonds Division, U. S. Treasury Department, Washington, D. C. Your State Director, U. S. Treasury Department, will show you how easy it is to build a successful Payroll Savings Plan.

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

IRON AND STEEL ENGINEER



This 30″ Bore Fast's Coupling is on the main drive of the blooming mill at a large Eastern steel mill . . . one of many Fast's linking power to production at this installation.

For SAVINGS up to $30,000 per hour... FAST'S Couplings are FIRST!

A coupling failure in the steel mill installation shown here would cost this mill $30,000 for every hour of down-time! That a Fast's Coupling was selected for this vital spot is striking testimony to the reputation for rugged dependability Fast's Couplings have enjoyed through the years. And Fast's guarantees *you* the same protection against costly shutdowns, whatever your coupling applications!

Remember: Fast's Couplings give you *rugged construction* . . . the original design has been maintained without basic change or sacrifice in size or materials. Fast's Couplings give you *lowest* cost per year . . . *Fast's usually outlast the equipment they connect.* And Fast's Couplings give you the benefit of Koppers *free engineering service* . . . assuring you of the right coupling for any job and the right solutions to tough coupling problems.

For full details on how Fast's Couplings and Koppers Engineering Service can help you insure uninterrupted power transmission, write today for your free copy of our catalog to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 311 Scott Street, Baltimore 3, Md.

KOPPERS®

THE ORIGINAL

FAST'S Couplings

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers-Elex Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus.

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Gentlemen: Send me a Fast's Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs.

Name .....

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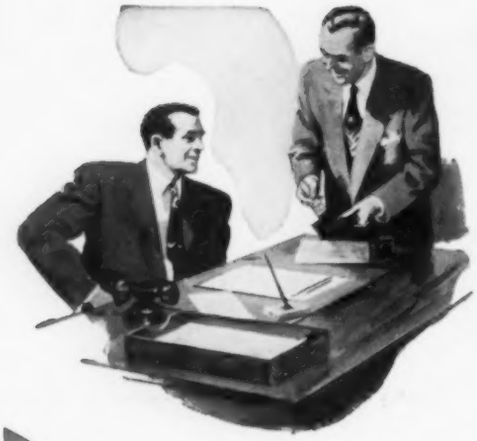
Address .....

City ..... **Zone** ..... **State** .....



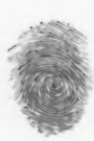
SEE RUST-OLEUM APPLIED DIRECTLY OVER SOUND RUSTED SURFACES! MAKE THIS TEST UNDER YOUR OWN CONDITIONS AND SEE PROOF OF PERFORMANCE!

See Rust-Oleum 769 Damp-Proof Red Primer actually applied over a badly rusted surface after simple scraping and wire-brushing to remove rust scale and loose rust in the Rust-Oleum *"rusted panel demonstration."* Rust-Oleum's specially-processed fish oil vehicle *penetrates* rust to bare metal usually eliminating sandblasting and other costly surface preparations.

Rust-Oleum finish coatings in Aluminum, Green, White, Gray, Yellow, Black, Orange, Blue and others provide both *Rust Prevention* and *Decorative Beauty!* Specify Rust-Oleum for new construction, maintenance, and re-modeling. See Sweets for complete catalog and nearest Rust-Oleum Industrial Distributor, or attach coupon to your business letterhead.

RUST-OLEUM®

STOPS RUST!



There Is Only One Rust-Oleum. It Is Distinctive as Your Own Fingerprint. Resists Rain, Sun, Fumes, Snow, Heat, Salt Air, Salt Water, etc.

See local classified telephone directory under Rust Preventives or Paints for nearest Rust-Oleum Industrial Distributor.

ATTACH TO YOUR BUSINESS LETTERHEAD AND MAIL TO:
Rust-Oleum Corporation, 2441 Oakton St., Evanston, Ill.

- ☐ Please Show Me the Rust-Oleum "Rusted Panel Demonstration."
- ☐ Test Application of Rust-Oleum Over Rusted Metal Surfaces in My Plant.
- ☐ Complete Literature with Color Chart.
- ☐ Nearest Rust-Oleum Industrial Distributor.

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F 85 ALLOY CAST STEEL BUCKETS

Finest Name in Cast Steel!

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HIGHEST QUALITY ELECTRIC FURNACE CARBON AND ALLOY STEEL CASTINGS

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"True Tooth" Gears and Pinions, Sheaves and Wheels.

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HEAVY HARDWARE
Complete Line Wire Rope Fittings and Cutters, Bar Benders and Cutters.

YOUR INQUIRY WILL PROMPTLY BRING DETAILED INFORMATION PERTAINING TO ANY OF THE ABOVE FARRELL-CHEEK PRODUCTS

SANDUSKY, OHIO

HAGAN
AIR-OPERATED CONTROLS
FUEL SAVING
HAGAN
RING BALANCE INSTRUMENTS

The primary purpose of every installation of Hagan Combustion Controls and Instrumentation is to save fuel.

Hagan equipment and Hagan methods have always been in the lead in implementing improved fuel burning practices. Hagan engineering skill has contributed materially to the success of many new methods.

Each unit of a Hagan System is built to give accurate and dependable service with minimum maintenance requirements. The complete series of components enables Hagan engineers to select exactly the right units for a fully coordinated system of Hagan Automatic Control and Instrumentation.

Hagan Ring Balance Instruments are the most versatile and reliable for providing the accurate records necessary in proper evaluation of performance. Standard designs are available for measuring and recording all the factors which affect combustion efficiency.

Is Our Business

The diversity of applications of Hagan equipment may be judged from these examples of successful installations.

Automatic control of blast furnace blower delivery, with automatic compensation for barometric pressure and air temperature.

Automatic combustion control, drum water level control and flow metering for boilers of all sizes and pressures, fired with all types of fuels, singly or in multiple.

Automatic controls and instrumentation for open hearth furnaces, soaking pits, heating furnaces of all types — including total heat input control for single or multiple fuel firing, fuel-air ratio control, furnace pressure control and automatic reversal.

Automatic control of fuel-air ratio for blast furnace gas burners on stoves and boilers.

Automatic control and metering for gas mixing stations on a ratio or Btu basis.

Flow metering for oxygen supply systems, with automatic correction for pressure and temperature variations.

Flow metering of natural gas, correcting automatically for pressure and temperature.

Metering and automatic controls for coke oven collector mains, exhausters, boosters, stacks and underfiring.

Whether for modernization or extension of existing installations, or for new construction, our engineers will be glad to suggest the best system to fulfill your requirements.

HAGAN CORPORATION

HAGAN HALL BUROMIN CALGON

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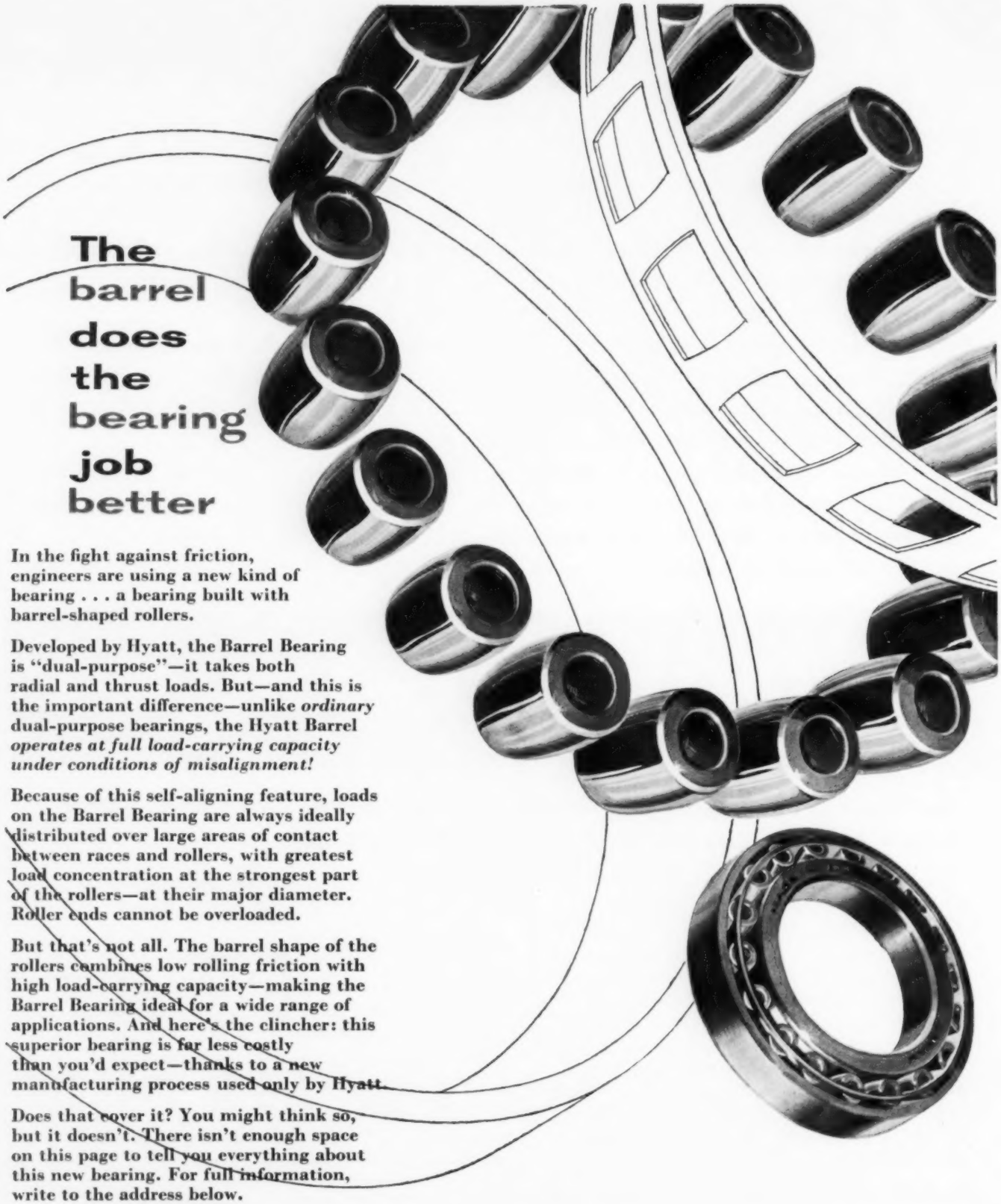
Boiler Combustion Control Systems • Ring Balance
Flow and Pressure Instruments • Metallurgical
Furnace Control Systems • Control Systems
for Automotive and Aeronautical Testing Facilities



The barrel does the bearing job better

In the fight against friction, engineers are using a new kind of bearing . . . a bearing built with barrel-shaped rollers.

Developed by Hyatt, the Barrel Bearing is "dual-purpose"—it takes both radial and thrust loads. But—and this is the important difference—unlike *ordinary* dual-purpose bearings, the Hyatt Barrel *operates at full load-carrying capacity under conditions of misalignment!*

Because of this self-aligning feature, loads on the Barrel Bearing are always ideally distributed over large areas of contact between races and rollers, with greatest load concentration at the strongest part of the rollers—at their major diameter. Roller ends cannot be overloaded.

But that's not all. The barrel shape of the rollers combines low rolling friction with high load-carrying capacity—making the Barrel Bearing ideal for a wide range of applications. And here's the clincher: this superior bearing is far less costly than you'd expect—thanks to a new manufacturing process used only by Hyatt.

Does that cover it? You might think so, but it doesn't. There isn't enough space on this page to tell you everything about this new bearing. For full information, write to the address below.

HYATT ROLLER BEARINGS

STRAIGHT ▯ BARREL ▯ TAPER ▯

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION • HARRISON, N. J.

Equipment News...

MAGNETIC SKELP ROLL

▲ Developed by Eriez Manufacturing Co. is a new permanent magnetic skelp roll to replace electro rolls in propelling skelp into furnaces. Under conditions of actual mill use, the new unit has proved itself more efficient, and far less costly in terms of maintenance and down-time, than equipment previously available.

A prime virtue of the skelp roll is its simple, rugged construction. Essentially, the unit consists of a heavy steel shaft on which are keyed two strong cast aluminum hubs; attached to these is the magnetic element itself, composed of heavy Alnico V bar castings, which in turn is covered by the outer, cylindrical steel pole rings or shoes.

Inherent in the permanent magnetic unit are certain characteristics that make for particularly efficient operation. Unaffected by heat up to 700 degrees F, the initial roll can be installed two ft from the furnace. Because of their greater magnetic strength, the units afford more positive control of the skelp, and reduce slippage, allowing rolls to be operated at slower speeds, if desired. Since the magnetic field is extremely powerful, varying widths and thicknesses of skelp can readily be handled.

Reductions in maintenance and downtime afforded by the units are particularly interesting. Since burnouts are completely eliminated in the non-electric rolls, the high cost of rebuilding—and the attendant cost of down-time — characteristic of electros, is likewise eliminated.

There is no maintenance of rheostats, motors or synchronizing controls, since none of these accessories, essential to electro rolls are needed for the units. Because of the reduction in slippage, due to superior strength, rolls last longer. (When pole rings finally become worn out, they can be easily replaced in the field, by any workman, without disturbing the magnetic circuit.) Also eliminated is the cleaning of collector rings—and, of course, the need to provide for direct current. Finally, the permanent magnetic unit requires virtually no maintenance itself, and will retain its magnetic strength, unimpaired, indefinitely.

Essentially a holding magnet, the skelp roll is capable of a certain amount of pulling, as well as holding, and is recommended as being well adapted to the transfer of sheet or strip material.

TRAILER

▲ Dominion Foundries and Steel Limited of Hamilton, Ontario is being equipped with special 35-ton Fruehauf carryall trailers for the purpose of hauling hot ingots from the soaking pits at the main plant of Hamilton to the rolling mill about one and one-half miles distant.

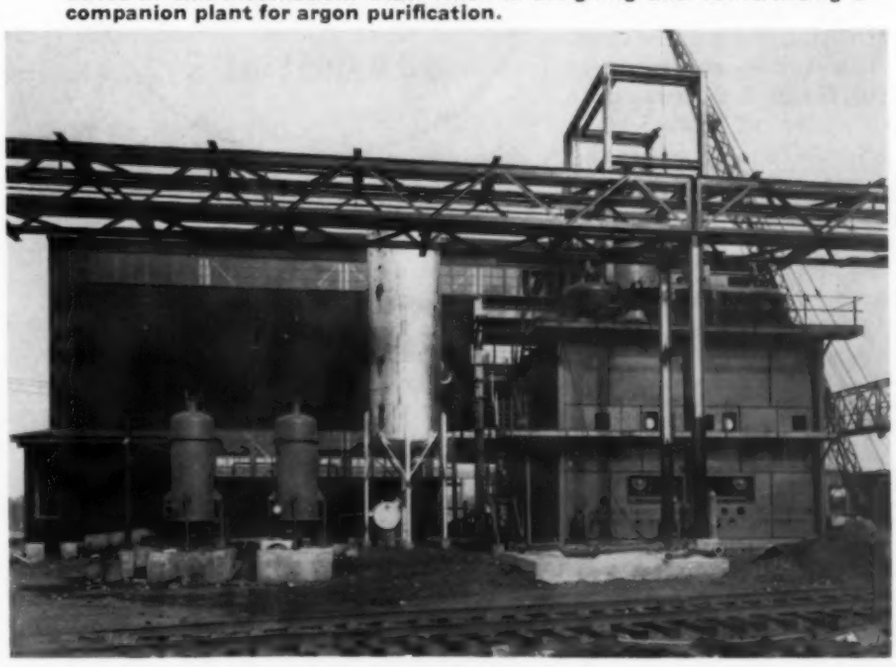
By moving these ingots white-hot from the soaking pits and putting them immediately into the rolling mill a complete-reheating operation is eliminated, resulting in important economies. The difficulty, of course, has been to load, haul and unload expeditiously enough to avoid cooling of the ingots to such a degree that they cannot be worked on the rolling mill. This has been solved by rapid loading by overhead crane into a specially constructed body mounted on the trailer, designed by Phil Wood Industries of Windsor, Ontario. This body is insulated with fire-clay and asbestos and rests on rails mounted on a special Fruehauf carryall chassis.

The body holds 20 tons of ingots, each being about $3\frac{1}{3}$ tons in weight. The body alone weighs 20 tons and is hinged at the ends so that the ends fold over and become an insulated cover holding the heat of the ingots long enough for the $1\frac{1}{2}$ mile haul to be made. The hinged ends of the body fold over acting as covers. This operation is actuated by vertical hydraulic hoist equipment.

Many precautions had to be taken in the design of both the chassis and body. The ingots are loaded into the special unit at a temperature of about 2300 degrees Fahrenheit. A temperature drop not to exceed 160 degrees F has been experienced on the haul. This is not sufficient to cause any concern in the processing of the ingots.

BLAW-KNOX BUILDS OXYGEN PLANT AT McLOUTH

Being erected by Chemical Plants Division, Blaw-Knox Co., for the McLouth Steel Corp. at Trenton, Mich. This large tonnage oxygen plant represents important milestones for the chemical and steel industries. Due to go on stream later this fall, the plant will be the first Linde-Fraenkl cycle-type process to produce high purity oxygen in this country. Blaw-Knox is the United States supplier for the process. Crude argon is also produced in this installation. Blaw-Knox is designing and constructing a companion plant for argon purification.



Ideal for use in foundries and small metal producing plants, these machines provide exceptional economy and durability due to a unique design feature. The endless chain carrying the mounds runs over a series of "stationary wheels" mounted on the frame, rather than in the chain as on conventional units. This keeps the wheels as far as possible from the hot metal and eliminates 80% of the moving parts. Results are increased capacity and a substantial reduction in maintenance and operating costs. Capacities: 3 to 50 tons per hour. Lengths: 15 to 125 feet, in multiples of 5 feet.

WILLIAM M. Bailey COMPANY
ENGINEERS
LEADERSHIP THROUGH QUALITY
1221 BANKSVILLE ROAD PITTSBURGH 16, PA.

The hot ingots are loaded into the body by overhead crane and unloaded by tongs which pick up the hot ingots and immediately transmit them to the rolling mill.

In the design of the chassis particular care had to be taken that no damage was suffered by the unit because of the excessive heat of the load. Basically, the carryall is a 35-T special Fruehauf unit with Model TL-55 axles. The tires are 10x20 special high pressure units, 14-ply Michelin, high pressure type, carrying a pressure of 100 lb. They are mounted to the outside to be clear of the hot body in order to avoid damage to the rubber.

The structure of the chassis requires the use of four main 12 in. H beams which are the carrying members for the load. The body rests on rails on these supports and is completely insulated with fire clay insulation. The body itself weighs the same as the load—20 tons. This unit has already started in operation and has proven highly successful.

LUBRICANT

▲ Scientists at Armour Research Foundation of Illinois Institute of Technology have found an economical domestic substitute for palm oil as a lubricant in the cold rolling of steel.

Recent investigations revealed that a substitute based on animal fat materials proved to be both adequate and economical, according to John P. Sheehan, supervisor of mechanical metallurgy in the metals research department of the Foundation.

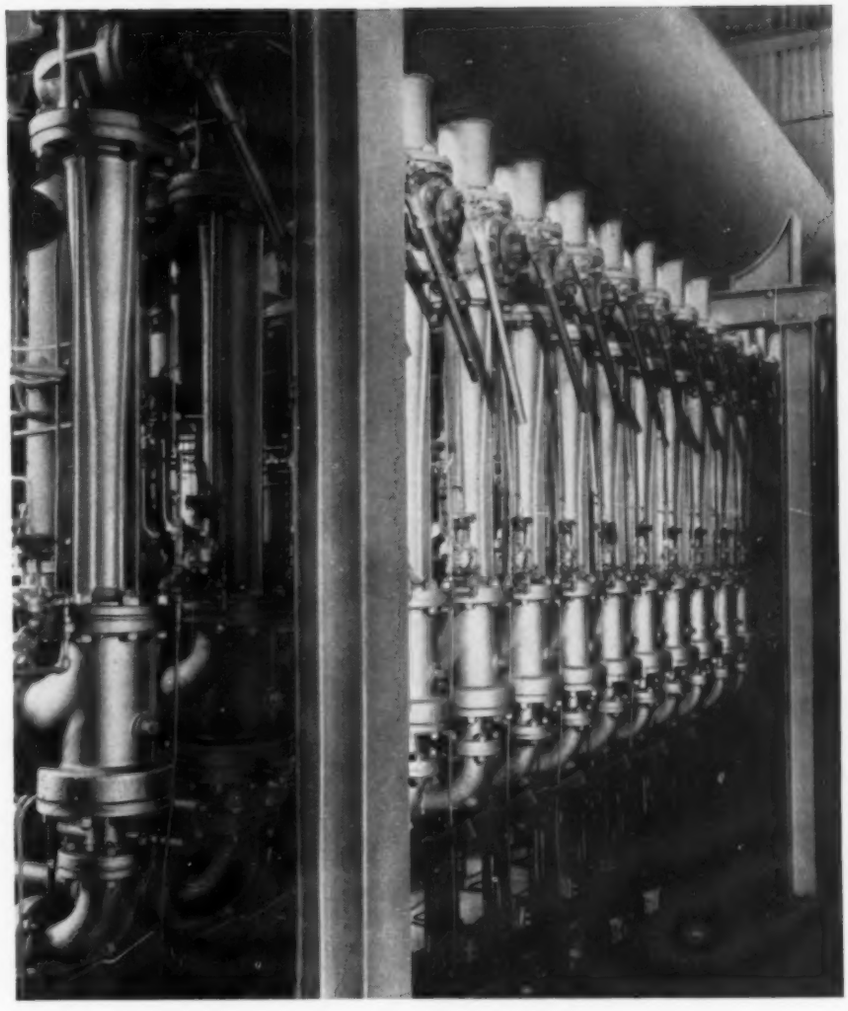
"Tallows, readily available from meat packing concerns in sufficient quantities, can be processed into a lubricant which can be used by the steel industry in its cold rolling operation," he said.

The search for a substitute for palm oil was conducted at Armour Research Foundation under sponsorship of the American Iron and Steel Institute.

The substitute developed at Armour Research Foundation will provide the steel industry with a product that is domestic, economical, and available in sufficient quantities, it was pointed out.

This research was preceded by a similar project at the Foundation, dealing with hot dip tinning, which

PIPE ORGAN FOR HOT TUNES



I-R Ejector Jets automatically maintain desired BTU content of gas mixture for firing metallurgical furnaces at Fairless Works.

The pipes in this "organ" produce no music. Yet the steady roar of gases which they control is music to the ears of the utility men at U. S. Steel's new Fairless Works. For this bank of fifteen I-R ejectors plays a major role in keeping the furnace fires burning at constant, high efficiency.

The reheating and pit furnaces at Fairless normally burn coke oven gas. At times, however, there isn't enough of it and natural gas must be introduced as fuel. If the natural gas were burned in its virgin state the burners would have to be readjusted every time, since coke oven gas has only half the BTU value of natural gas. That's where the jets come in. They mix just enough air with the natural gas to give it the same heat flow factor as coke oven gas. The natural gas is expanded through the nozzle of the jet, picking up air through the suction. Gas flow is regulated automatically according to load requirements by cutting any of the fifteen jets into or out of the system.

This is another example of how Ingersoll-Rand experience in the design and engineering of steam jet ejectors was able to solve a specific operating problem. The same time-saving, cost-saving service is available for *your* problems, too. Just call your nearest I-R representative or branch office.

Ingersoll-Rand

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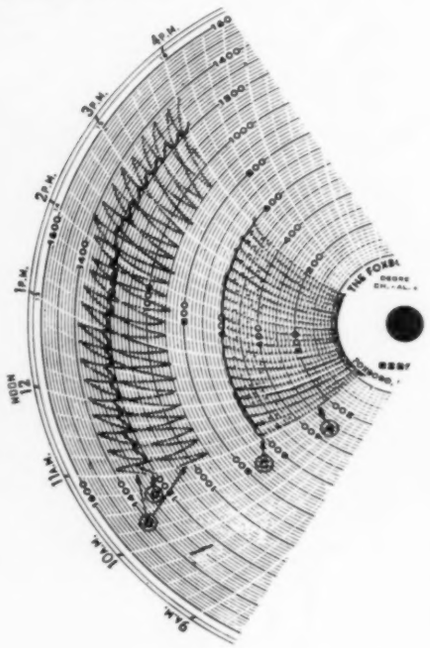
PUMPS • COMPRESSORS • GAS & DIESEL ENGINES • ROCK DRILLS • VACUUM EQUIPMENT • AIR & ELECTRIC TOOLS & HOISTS

led to the development of a tinning oil compounded from high grade beef tallow in 1951.

ELECTRONIC RECORDER

▲ A one-instrument "control-panel-within-a-panel," installed on the open hearth furnace control board at Jones and Laughlin Steel Corp.'s new Pittsburgh works, keeps the furnace at peak temperature and protects checker brickwork from overheating. The instrument, a multiple record Dynalog electronic recorder manufactured by the Foxboro Co., continuously logs six important furnace temperatures on one circular chart and reverses firing direction whenever waste gas temperatures reach pre-set values.



Reversal is initiated by either of two conditions: first, when the temperature difference between the two checker atmospheres reaches a pre-set value, or second, when the waste gas temperature at either checker reaches a pre-set maximum.

Reversal by temperature difference measurement ("A" portion of the chart) occurs automatically when a pre-set difference is reached. A setting knob in the instrument permits the furnace operator to adjust the temperature difference span when shorter reversal periods are desired toward the end of the heat. Overriding this control are high temperature contacts which initiate reversal in the event of an overheated exit flue ("B" portion of the chart).

(*Please turn to page 245*)

Efficient Production

Helped by SKF's Brand of Anti-Friction Science

Where can you cut costs in steelmaking by applying the science of anti-friction to your operations?

Jones & Laughlin Steel Corporation takes advantage of SKF's unique Field and Home Office engineering service to improve efficiency in many ways—in ingot car journals, tension and payoff reels, upcoilers, temper pass mills, rolling mill drives. For more than a quarter of a century, Jones & Laughlin—as well as other progressive steel producers—have depended on SKF to increase their operating efficiency through skilled application of the science of anti-friction.

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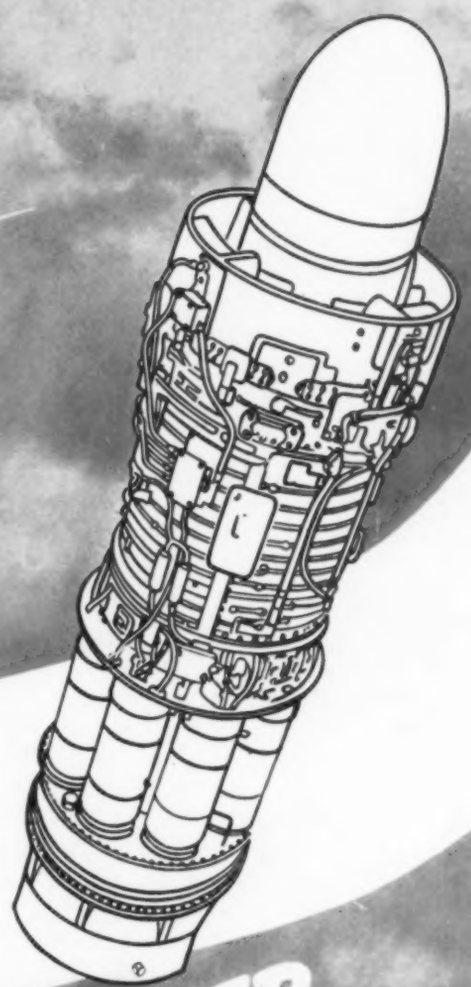
Heat Treating

AN IMPORTANT FACTOR IN MAKING

Jet Engine Parts

The parts that go to make up a jet engine call for heat treating techniques as new as they are varied. Drever's long experience, through its own commercial heat treating division, has provided welcome solutions to many new problems of furnace design encountered in this field. Drever builds heat-treating furnaces of many types, with special adaptability to treating Stainless Steels of the 300 and 400 series, as well as Nimonic, etc.

Drever furnace application engineers will look forward to the opportunity of discussing your problem with you.



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BRIGHT ANNEALING AND BRIGHT HARDENING OF SMALL PARTS
CONTINUOUS ANNEALING OF WELDMENTS, STAMPINGS, ETC.
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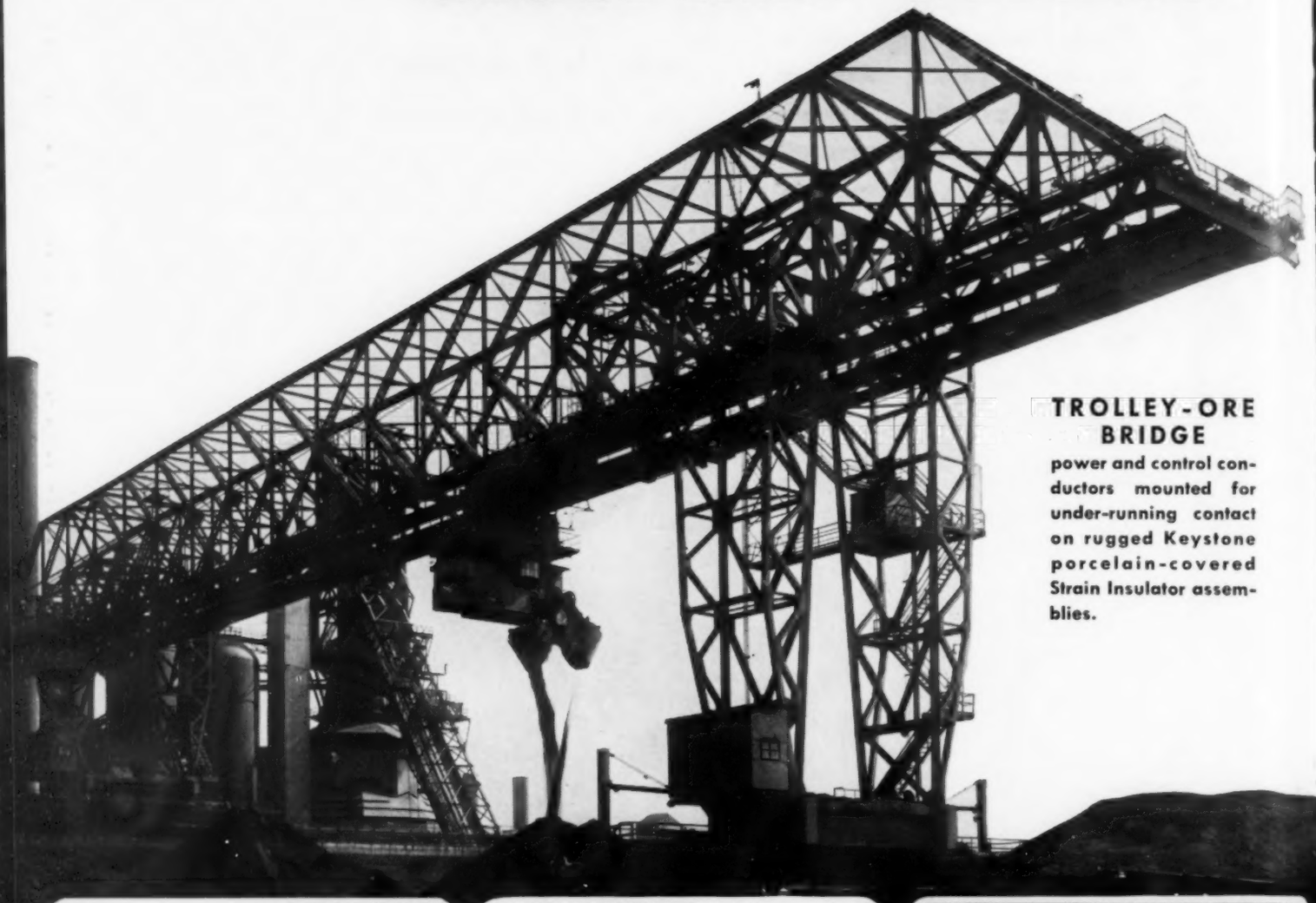
BATCH OR CONTINUOUS TYPE FOR STRESS RELIEVING
Also installations for caustic descaling including quench and acid dip tanks

DREVER CO.

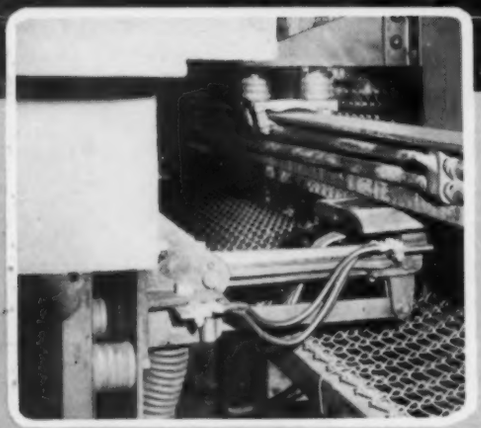
RED LION ROAD & PHILMONT AVE.
BETHAYRES, PA.

8

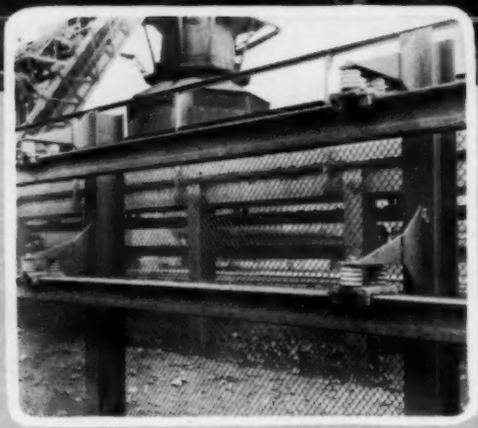
World's Newest Steel Mill Selects



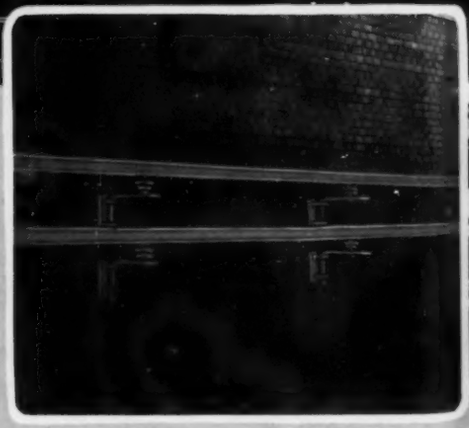
TROLLEY-ORE BRIDGE
power and control conductors mounted for under-running contact on rugged Keystone porcelain-covered Strain Insulator assemblies.



RUNWAY-ORE UNLOADER
Keystone Type PS Collector heavily constructed for severe service. Both contact rails and collectors insulated with Keystone Glastic Insulators.



RUNWAY-ORE BRIDGE
equipped with Keystone Glastic Contact-rail Insulator assemblies for under-running contact-rail service.



COKE QUENCHER
Power rails equipped with Keystone wet-process porcelain petticoat-type Insulators providing long leakage distance for wet, dirty applications.

ELECTRIC SERVICE MANUFACTURING CO.,

SERVICE ENGINEERED

KEYSTONE INSULATORS

FOR UNFAILING PROTECTION

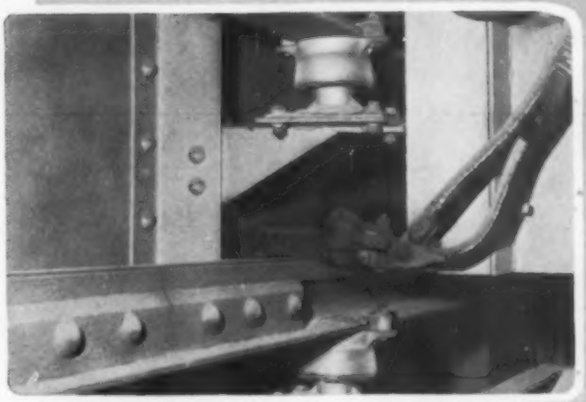
When U. S. Steel engineers built the Fairless Works to be the most modern mill in the world they had to consider every product for peak efficiency. For insulators on power lines and rails Keystone Insulators were selected and installed from the ore unloader right on through the plant.

Keystone Insulators are "service engineered" to take the toughest treatment on all installations. They have been proved and approved by years of unfailing service in the leading industrial plants throughout the world. They include:

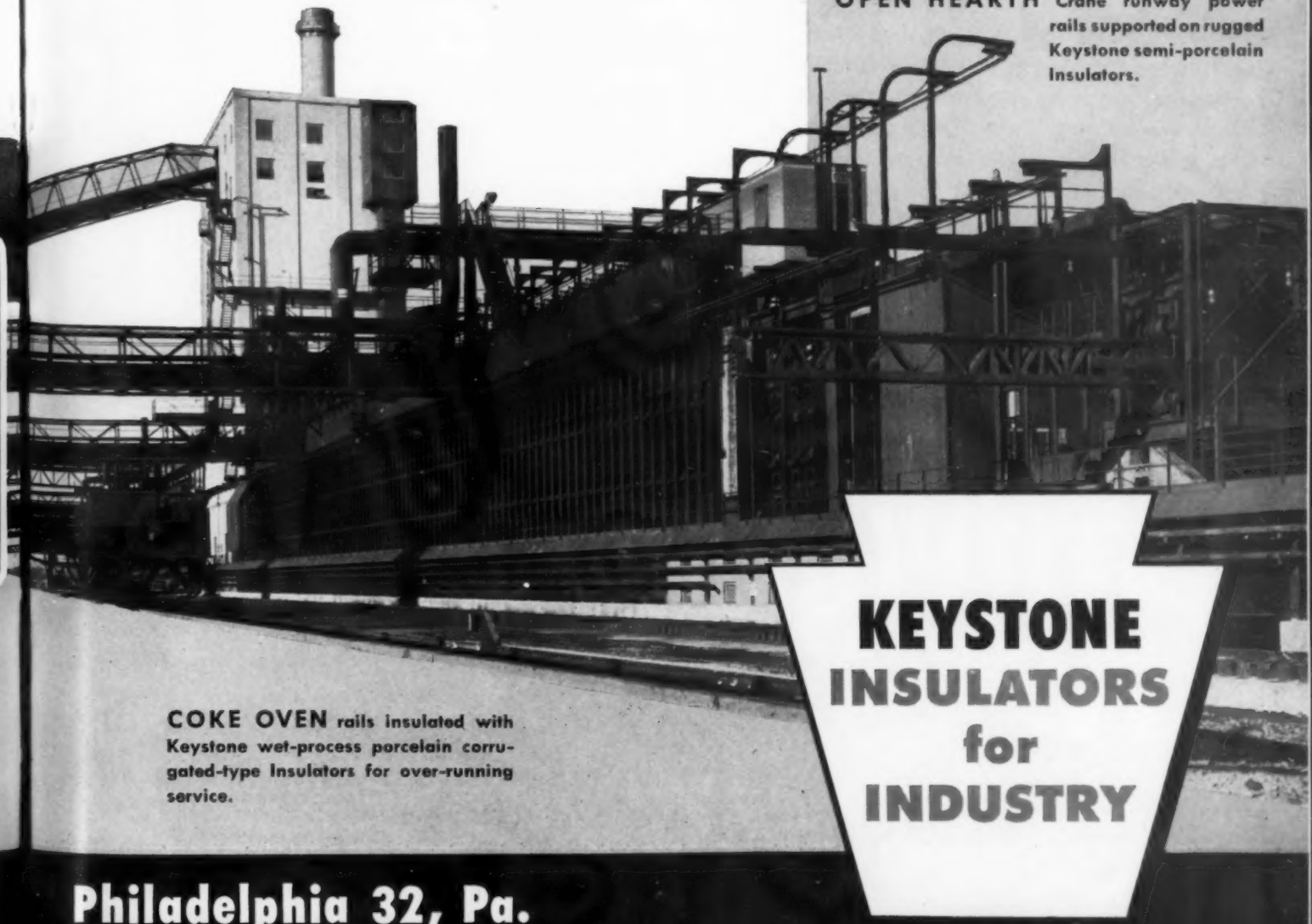
Moulded Glastic Insulators
Wet-Process Porcelain Insulators
Semi-Porcelain Insulators
Moulded Phenolic Insulators

For long, strong life and peak protection there's a Keystone Insulator that is "service engineered" to meet every need in your plant. Let ESM engineers help you select the right mechanical and electrical qualities to solve your problems. Write today for complete catalog on these Insulators, Keystone Collectors and Rail Shoes.

SOAKING PIT Crane runway power conductors equipped with Keystone semi-porcelain type Insulators with Keystone phenolic type Giant Strain Insulators providing double safety.



OPEN HEARTH Crane runway power rails supported on rugged Keystone semi-porcelain Insulators.



COKE OVEN rails insulated with Keystone wet-process porcelain corrugated-type Insulators for over-running service.

KEYSTONE INSULATORS for INDUSTRY

Philadelphia 32, Pa.

Oil Immersed
Safety Line Disconnect Switches

620 Series

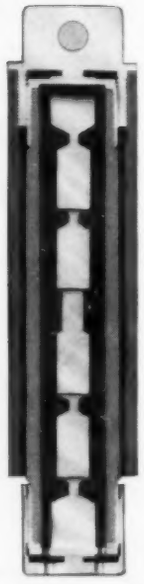
30 - 60 - 100 - 200 - 400 amp. available for 250 and 600 volt service.

Rowan Series 620 Fused and Unfused Safety Switches are designed to provide dependable service in all locations, especially those where the atmosphere is corrosive, as in chemical plants, oil refineries, steel or cement mills.

Switches are supplied with cast iron tops and welded steel tanks; special floor-mounted units are made of high quality steel. Enclosures are NEMA Type XI . . . also available in NEMA Type VIII in which all electrical connections are at least six inches under oil.

Standard features of these units include the following: completely oil immersed; equipped with Rowan time-tested AIR-SEAL fuses; disconnect switch of the quick-acting contactor type with renewable contacts; top and tank mechanically interlocked with disconnect switch to prevent lowering of tank when switch is in the closed position; provision for padlocking disconnect switch in OFF position; weather resistant enclosing case; provision for lowering tank for inspection without removing tank.

Complete information available from Rowan representatives located in principal cities throughout the country.



Cutaway view shows unique design of Rowan low-voltage AIR-SEAL fuse for use under oil.

ROWAN CONTROL

THE ROWAN CONTROLLER CO., BALTIMORE, MD.

(*Continued from page 240*)

Four temperature points of the six-point recorder are devoted to reversal control, with the remaining two used for atomizing steam temperature ("C") and stack temperature ("D"). Thermocouple sensing elements are used for all six points.

Each of the six temperatures is recorded in a distinctive color, easy to distinguish. Each day's chart is kept on file so that furnace conditions can be closely "watched" and day-to-day comparisons made. Thus, potentially dangerous conditions are spotted in advance and corrected.

REFRACTORY GUN

▲ Designed specifically for air-emplacement of granular basic refractories, a new refratcory gun introduced by Basic Refractories, Inc. offers a quick, economical method of repairing linings in electric and open hearth steelmaking furnaces, soaking pits, heating furnaces and cupolas.

Greater simplicity, more rugged construction, and an enlarged 20 cu ft hopper capacity are the outstanding features of this new gun. One of the greatest improvements over earlier models, is the addition of an operating platform, which provides for easier loading and greater accessibility to the control panel. All smaller models will be provided with the new operating platform.

SPEED REDUCER

▲ Just announced by the Cleveland Worm and Gear Co. as the newest addition to its line of power transmission equipment is a variable speed re-

Amazing new Taylor Made
ALLOY STEEL
TAYCO HOOKS

- Extra area above eye assures longer life!
- Large eye reduces joiner link wear!
- I-Beam type design assures greater strength—provides grip for hooker!
- Drop Forged from heat-treated alloy steel!
- Wider, deeper throat!
- Resists twisting to greater extent than conventional sling hooks!

Pat. No. 2,646,306

TAYCO SLING HOOK

TAYCO GRAB HOOK

Stronger–safer–lasts longer than conventional hooks!

Patented I-Beam type *design*... Taylor's *special analysis alloy steel*... plus complete heat-treatment are reasons for the greater strength and longer life of Tayco Hooks. A larger eye, greater area above the eye and a bigger neck are additional factors. More resistant to shock, grain-growth, work-hardness and side bending than regular hooks. Will not open even under *dangerous point* loading until the working load limit of the chain (for which it is designed) is exceeded! I-Beam design provides a safe gripping area—permits handling more tonnage with less fatigue! Cut replacement and repair costs with Tayco Hooks!

S. G. TAYLOR CHAIN COMPANY
General Offices and Plant, Hammond, Ind.
Eastern Sales Office and Plant, Pittsburgh, Pa.

Send coupon today for free folder!

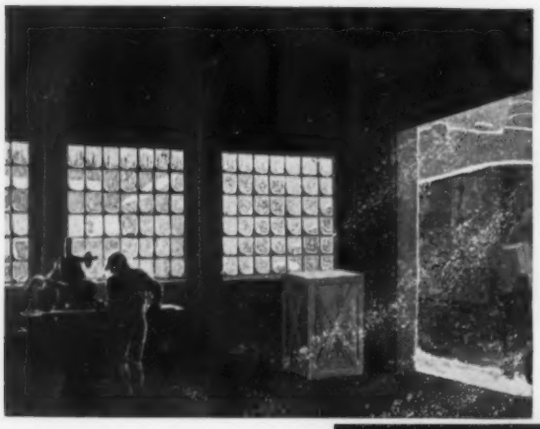
TAYLOR MADE
A GREAT NAME IN
Chain SINCE 1873

S. G. Taylor Chain Co.
Dept. H
Hammond, Indiana
Rush Free copy of Bulletin No. 90

Name_____

Address_____

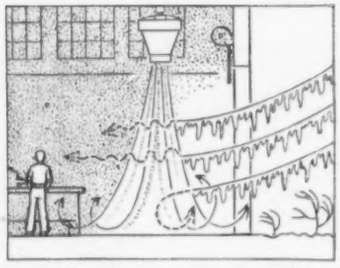
City_____ State_____



When Winter Comes—

Keep Production Moving with

WING DOOR HEATERS



A curtain of warm air tempers the incoming icy blasts to a comfortably warmed current of air.

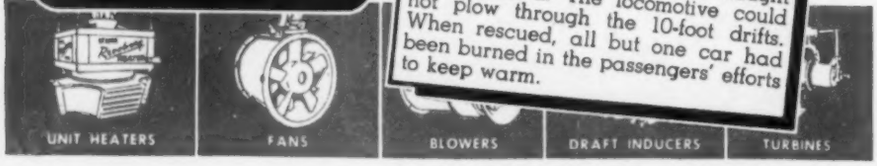
Cold blasts from open doors are stopped in their tracks by Wing Door Heaters, which go into action automatically when the door is opened. The high velocity curtain of warm air keeps working areas comfortable, preventing the chilly drafts from entering. Workers are healthier, happier, keep right on working when doors are open. Learn how easily Wing Door Heaters can be installed in your plant. Write today for a copy of Bulletin DH-1.

L. J. Wing Mfg. Co.
142 Vreeland Mills Road
Linden, N.J.

Factories at Linden, N.J. and Montreal, Can.
In Europe: Etab. Wanson, Brussels, Belgium

OUR 75TH YEAR 1879
Wing

SEVENTY-FIVE YEARS AGO
Travel in 1879, when the L. J. Wing Mfg. Co. was founded, was a hazardous undertaking. 100 people on a Michigan Central train enroute to Chicago were caught in a blizzard. The locomotive could not plow through the 10-foot drifts. When rescued, all but one car had been burned in the passengers' efforts to keep warm.



ducer, available in nine sizes, ranging from one-half to 10 hp at 1750 input rpm.

The new variable speed reducer has several unique features, including the following: Power is transmitted from the input shaft to the output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts; Relative speeds of the two shafts are adjusted through a 9:1 range (from ⅓ to 3 times the input speed) by changing the angular positioning of the axles on which the balls rotate. The result of this extremely simple arrangement is an infinitely variable and stepless range of output speeds from one constant speed power source; Operating efficiencies of 75 to 90 per cent are easily maintained over a wide range of operating conditions; Coaxial input and output shafts rotate in the same direction, either clockwise or counter-clockwise; The extreme simplicity of construction makes possible accurate speed regulation without complicated linkage and without drift; Speed is regulated by a simple manual adjustment, with indicator, or by manual or power operated remote control devices; There is ample bearing support for both input and output shafts to carry overhung pulleys.

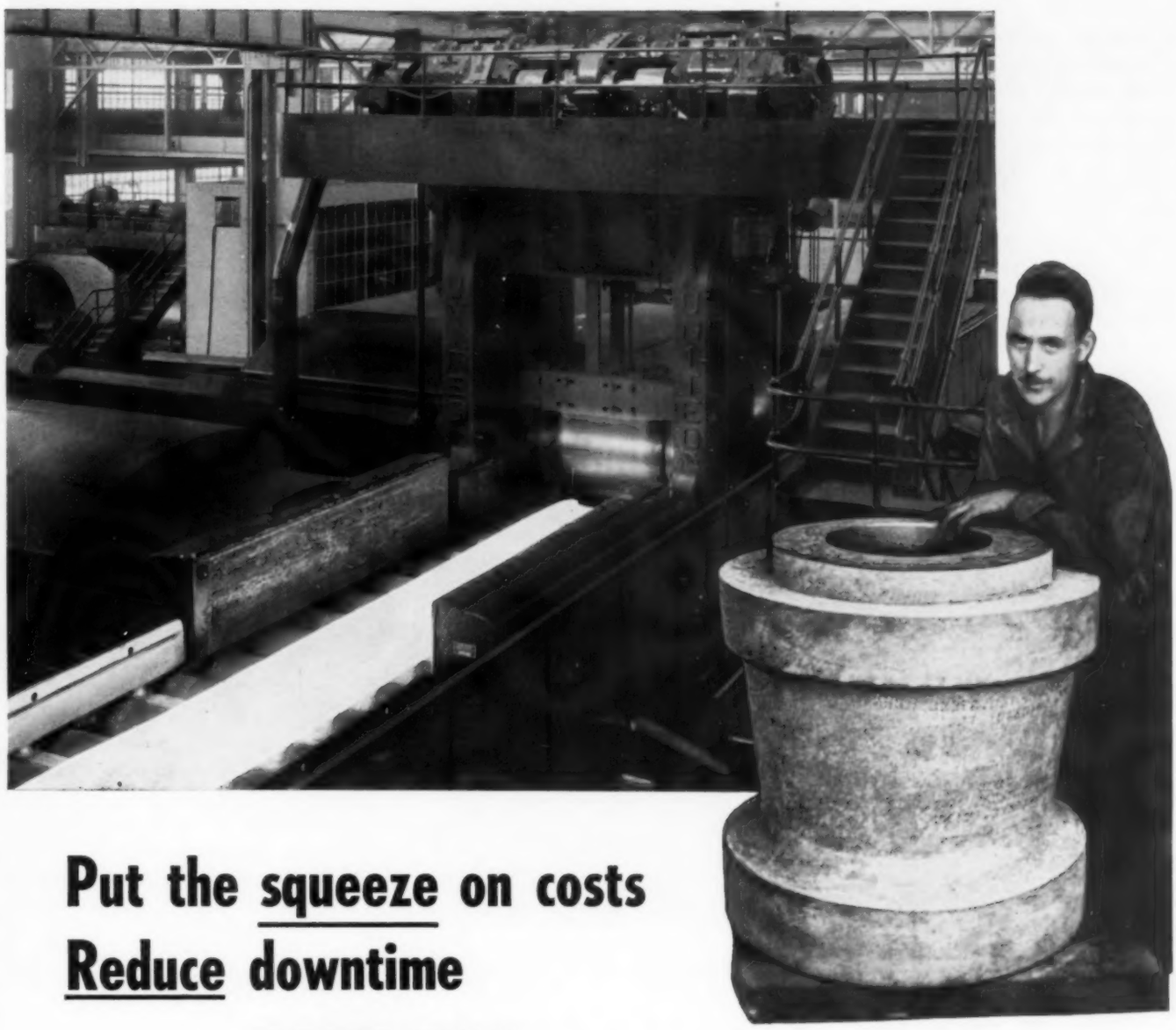
The prototype of the new unit is the Kopp Variator, invented several years ago by a Swiss engineer and manufactured in several countries of western Europe, where its simplicity and efficiency have established it as a leading, dependable variable speed transmission unit. The Cleveland Worm and Gear Co. has completely redesigned the Kopp unit to adapt it to American engineering standards and practices.

INSTRUMENTS

▲ Two new instrument lines—termed Speedomax "Type H" controllers and "Series 60" Proportional-Control Units—are announced by Leeds & Northrup Co.

Both are mounted in the Speedomax case when the equipment is to be used for proportional control. The control unit is also made as a separate instrument for use with the company's Speedomax Type G and Micromax controllers.

Type H is made in single-point only, and at present only for tem-



Put the squeeze on costs
Reduce downtime
...use AMPCO*

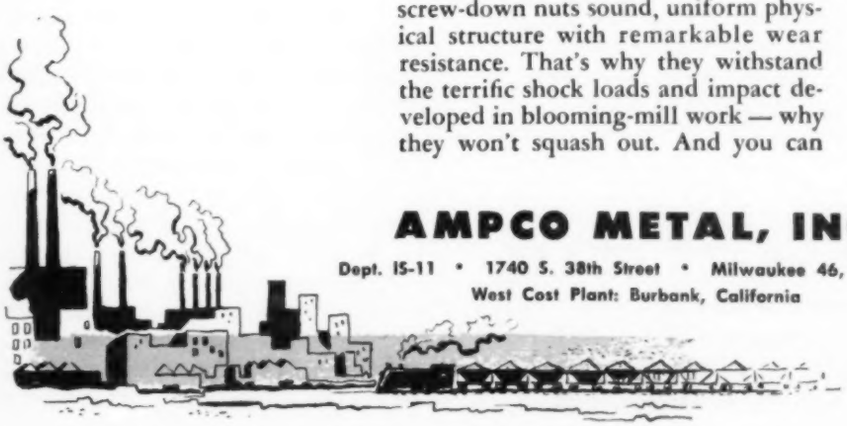
Screw-down Nuts

CUTTING costs is old stuff to Ampco Metal. And when Ampco is centrifugally cast into screw-down nuts for blooming-mills, you find no equal for top performance — lower costs — longer runs.

Centrifugal casting gives Ampco screw-down nuts sound, uniform physical structure with remarkable wear resistance. That's why they withstand the terrific shock loads and impact developed in blooming-mill work — why they won't squash out. And you can get Ampco screw-down nuts in sizes up to 6000 pounds.

Wherever extra toughness and wear resistance is important, you find Ampco Metal on the job — in slippers, wear plates, flash-welding dies. Its high resistance to corrosion saves money for you in pickling equipment and similar applications.

Your nearby Ampco field engineer is glad to give you full information. Contact him today or write us.



*Reg. U. S. Pat. Off.

AMPCO METAL, INC.

Dept. 15-11 • 1740 S. 38th Street • Milwaukee 46, Wisconsin

West Cost Plant: Burbank, California

AMPCO®

G-19

peratures, with thermocouple or "Thermohn" resistance thermometer as the sensing element. The instruments are said to have relatively long measuring scales and employ the full length in setting the control point, which is said to facilitate close control.

Structurally, the instrument is entirely new. Convenience features stressed include the chart feed, pen, and control-setters, and the location of terminals for thermocouples, etc., in a recess on the outside back of the instrument, for convenient installation and the protection of the instrument tubes, wiring and mechanism.

The Series 60 control unit functions "between" the Speedomax controller proper and the fuel valve or contactor in a proportional control system. Its job is to translate measurements into the correct regulating operations. It is made in three types, and the company says that one or another will meet the needs of any controllable process.

The unit replaces the company's Series 50, introduced in 1949. It features greater simplicity, interchangeability of PAT, DAT and Proportional units, plug-in construction, and the advances in sensitivity, speed and flexibility which many processes can use today and which more will require in the near future.

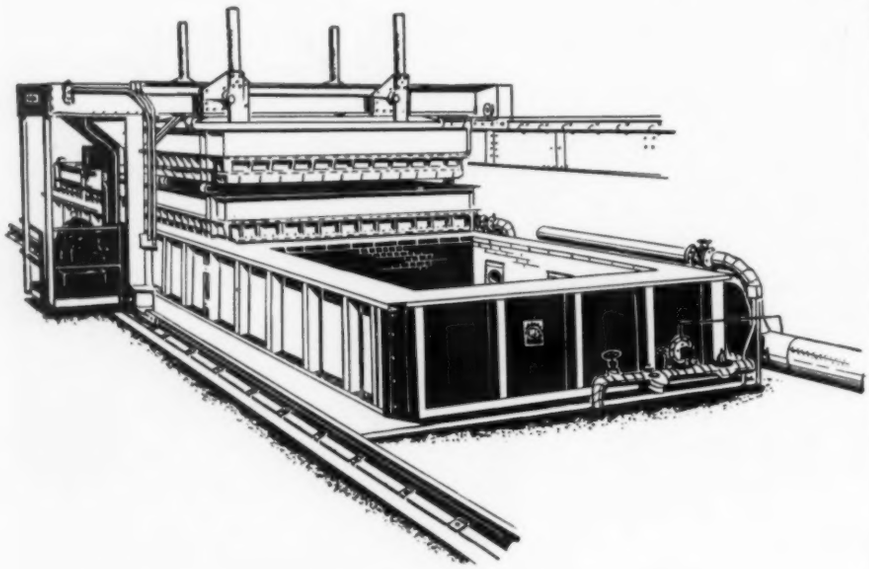
SHEAR GAGE REELS

Four Gleason Reels are in daily use on each of the two shear gages of the P1-10-in. bar mill in the Pittsburgh Works of the Jones & Laughlin Steel Corp. The two SHO-102 overhung cable reels shown on the left permit remote control of the travel motors which drive the two traverses. The LA-76 air hose reels (one out of sight) permit remote control of the gage stops.

CONVEYOR IDLER

▲ The Limberoller, a cable-suspension idler for belt conveyors offered by Joy Manufacturing Co., shapes itself to the load and has excellent resistance to abrasion. Suspended from two bearings which are up out of the dirt zone, it carries the belt on resilient, pressure-molded neoprene discs, all of the same size, and all revolving at the same speed. Discs are molded to a neoprene-sheathed, flexible steel cable. In continuous contact with the loaded belt, they exert a slight gripping action that holds slippage to a minimum, and tends to keep the belt aligned. Discs are also resistant to oil, flame and most chemicals except strong oxidizing agents and aromatic hydrocarbons. Bearings are locked in place with spring clips, and can be changed without interrupting material flow.

The unit is slot-mounted in special bracketed stands, which are assembled into conveyor sections, without bolts or cover sheets, by means of



PIT TYPE FURNACES

R-S Pit Type Furnaces are batch furnaces with a movable top through which work may be loaded and unloaded. They are furnished as direct-fired units for temperatures from 1000° F to 2500° F or forced convection units from 600° F to 1400° F, using oil, gas or electricity.

There are no size limitations on charge weight or length and depth of work heating chamber. Width is normally limited in order to keep the pit covers

R-S
QUALITY FURNACES SINCE 1908

R-S FURNACE TYPES

Hi-Head ● Batch ● Rotary Hearth ● Continuous Belt Conveyor ● Continuous Chain ● Continuous Pusher ● Continuous Pusher Tray ● Pit ● Continuous Roller Hearth ● Car Hearth

bed-frame-type channel rails. Brackets are also available for bolting the idler to any conventional section.

The Limberoller permits conveyor heights from 13¼ in. to 15¾ in., and is available for belt widths of 24 in., 30 in., and 36 in.

SMOKESCOPE

▲ A new instrument to aid in compliance with smoke control laws is available from Mine Safety Appliances Co.

Called the "MSA Smokescope," it has been demonstrated before municipal and industrial smoke abatement experts at professional meetings held a few months ago. Now in production, the unit is ready for distribution.

It can be used to determine whether or not fuel is being properly burned to gain full Btu advantage, since excessive smoke indicates it is not. In this respect, industry can put the Smokescope to work for greater efficiency in addition to improving its community relations through air pollution.

With the Smokescope, observers are able to view a standard reference disk, shaded to correspond with degrees of smoke density, against the background of a smoke plume.

Here's how it works: light from the area adjacent to the stack is transmitted through one tube of the instrument and through the reference film disk inside the tube to a front surface mirror. Reflected by the mirror, it passes through a lens to an image mirror where it may be directly compared with the smoke as seen through the other tube of the instrument. The reference film disk is placed at the focal point of the lens, and thus has the effect of placing the light rays reaching the eye in a parallel position. Film area is small and acts as a point source.

The lens used to project a virtual image of the reference film disk also serves to intensify the light in the reference standard optical path, compensating for the light loss at the reflecting surfaces.

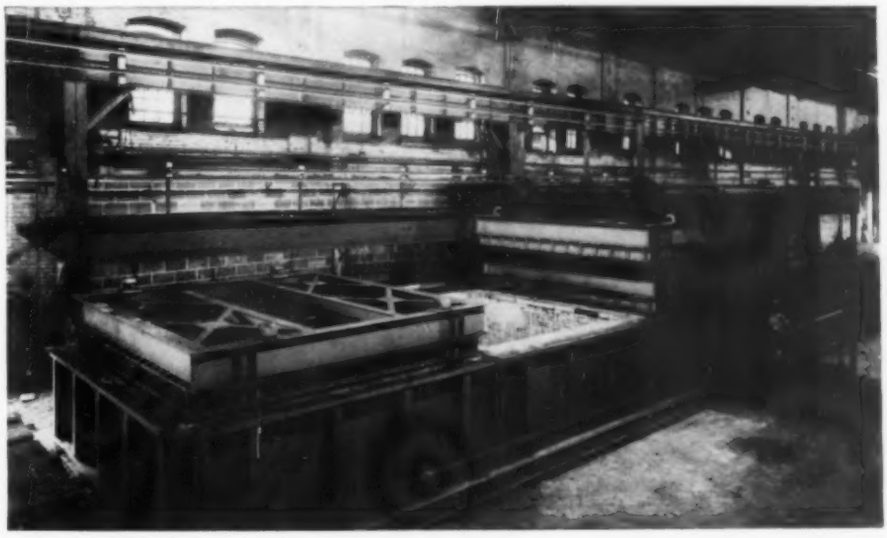
Field and laboratory tests were made by smoke control experts with advance models of the Smokescope, in which variations in size and shape of apertures, reference disks and light blocks were tried. The smoke control experts reported to MSA that they found no indications of error caused by background lighting of the smoke or ambient light near the observer.

PYROMETER

▲ A new device which makes it simple to change reference-junction compensators when going from one type of thermocouple to another is now available from the Bristol Co.

In previous multiple-point instruments, when a user wished to change thermocouples from one type to another for any reason, a tedious and time-consuming rewiring job on the multiple switch was necessary. The new Dynamaster Multiple-Point Pyrometer is a small, cylindrical aluminum piece, with an opening in one end into which a compensating resistor can be inserted. All the reference junctions are located in the wall of the cylinder. The extension wires necessary for all ISA approved thermocouples can be connected with the recorder with no cable changes. The instrument can also be used as a millivoltmeter.

To change from one thermocouple to another, the compensating resistor



Four R-S Pit Furnaces used as soaking pits for preheating. Oil-fired. Maximum temperature of 2000° F. Capacity of each — 33,000 pounds of steel ingots per hour. Size — 10'-6" square and 7'-6" deep.

within reasonable limits. Circular pits are available as well as the rectangular variety.

This type of furnace is used to heat metal for forging, rolling and forming operations in both the ferrous and non-ferrous fields.

Write today for Bulletin No. 200 describing the complete line of R-S Furnaces for metal heating and heat treatment.

R-S FURNACE CORP.
4555 GERMANTOWN AVENUE
PHILADELPHIA 44, PENNSYLVANIA

A SUBSIDIARY OF
HARDINGE COMPANY, INC.

R-S
QUALITY FURNACES SINCE 1908

is slipped out of the end of the unit and replaced with one of the correct value for the new thermocouple. Then the compensator wires at the input terminal block are loosened and replaced with the correct wires which are already available.

Because the thermocouple extension wires are kept to a minimum length within the instrument, and are not wired through the multiple switch, it is possible to obtain extremely good compensation. This permits high accuracy ratings on very low ranges.

DUPLICATING LATHE

▲ A 48-in. automatic roll contouring lathe is being built by Mackintosh-Hemphill Co. for the new 24-in. wide-flange beam mill now under construction at the Indiana Harbor plant of Inland Steel Co.

The electronically-controlled duplicating lathe will be capable of turning and redressing steel mill rolls up to 48 in. in diameter and 18 ft long. Operating from a stylus following a flat master template, cutting tool on the lathe will accurately machine structural-shape contours in the rolls.

Electronic contouring equipment will be supplied by Raytheon, Inc. General Electric will build the main drive motor, auxiliary motors, and controls.

While Mack-Hemp 60-in. automatic contouring roll lathes are already at work in roll shops of other leading steel companies, the new 48-in. machine is the first of this popular and widely applicable size.

J. R. Patterson, Mackintosh-Hemphill vice president, says the contouring lathe for Inland marks another step in the trend toward greater automation in steel mills. This lathe, Mr. Patterson points out, will be capable of machining the most complex roll shapes with only supervision, rather than effort, from the operator. It uses principally carbide tools.

Weighing 121,000 lb, the lathe will have an over-all length of approximately 41 ft.

VOLTAGE CONTROL

▲ Developed and introduced by Linde Air Products Co. is the electronically-controlled Heliare HWM-2 voltage control for use with mechanized inert gas shielded arc welding. It maintains a constant arc voltage to insure welds of uniform penetration and buildup. In addition, the unit automatically turns both torch cooling water and inert shielding gas on at the start and off at the finish of a weld.

The HWM-2 controls arc voltage by governing the distance of the torch from the work. For example, if arc voltage begins to drop, the "electronic brain" of the HWM-2 causes the torch head to raise and compensate for the dropping arc voltage. If the arc voltage starts to increase, the torch head automatically lowers to keep arc voltage constant. Thus, regardless of fluctuating welding voltage or changing surface contour, the HWM-2 maintains the constant arc voltage required for accurate and uniform welds.

SPRAYING SYSTEMS
descaling
SPRAY NOZZLES
for performance
in full measure

When you consider performance in all its aspects, here are spray nozzles for descaling that give outstanding full measure. Descaling itself is carried out with an efficiency as high as or higher than any other nozzle made. But equally important, Spraying Systems nozzles give you low first cost . . . **plus non-clogging design** that **reduces** the costs of down-time and maintenance to a minimum.

you can SEE the difference

Thin, high-impact, uniform spray

Open, elliptical non-clogging orifice

The thin, concentrated, uniform spray strikes with greatest possible impact for any volume and pressure . . . descales without excessive sheet cooling.

Clogging is practically eliminated by *elliptical*-shaped orifice . . . foreign matter goes right through.

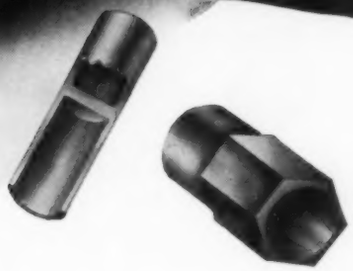
CHOICE OF SIZES . . . offered in 16 different capacities . . . for every known descaling use.

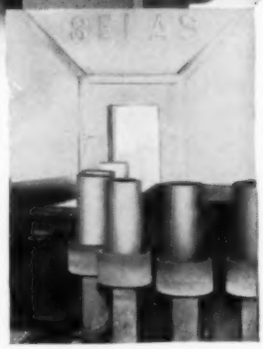
Designed and manufactured by America's leading producers of industrial spray nozzles. For complete information write for Data Sheet 6120.

SPRAYING SYSTEMS COMPANY 3262 Randolph Street Bellwood • Illinois

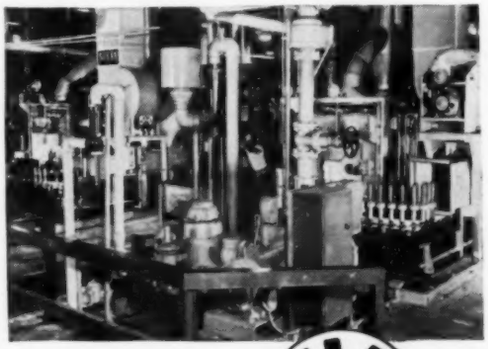
Spray Nozzles also supplied for such applications as Run-Out Table Cooling . . . Roll Cooling . . . Cooling Ingot Molds and many other uses. For complete information write for Catalog No. 24.

SELAS THERMO-AUTOMATION CUTS ANNEALING TIME BY 94%





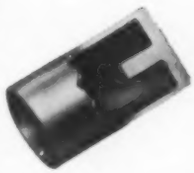
Selas Gradiation furnaces at Heintz Manufacturing Company's new cold extrusion plant.



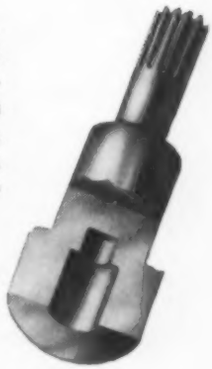
In-Line Continuous Heat Processing Steps Up Cold Extrusion Operations

Intermediate annealing of ordnance items between cold extrusion—cold forming press operations at Heintz Manufacturing Company, Philadelphia, has been reduced from 2 hours to 7 minutes per cycle, with Selas Thermo-Automation.

Selas automatic, precision-controlled heat assures metallurgical uniformity within each workpiece . . . in spite of varying cross-section . . . and reproducible uniformity from piece to piece . . . to meet rigid metal-flow requirements of cold extrusion methods. Gradiation high-thermal-head furnaces occupy less floor space, and reduce inventory of work in process. Scale is virtually eliminated.



This is another example of Selas Thermo-Automation at work. This advancement in heat processing offers tremendous possibilities for savings in time, labor and money . . . and the improvement of quality in heat treating, brazing, strip annealing and other continuous operations. Let us send you more details about Selas Thermo-Automation and how it can help you.



SELAS

SELAS CORPORATION OF AMERICA • PHILADELPHIA 34, PA.

Heat Processing Engineers for Industry • Development • Design • Manufacture

"They're Pumping Swell for J & L"

NAGLE PUMPS are used at Jones & Laughlin Steel Corp.'s Aliquippa Works, Otis Works, Vesta Shannopin Coal Preparation Plant, on the Mesabi range and at Benson Mines, Star Lake, N. Y. . . . doing a variety of pumping jobs . . . every one an abrasive, gritty pumping job . . . just the kind of pumping jobs Nagles take to.

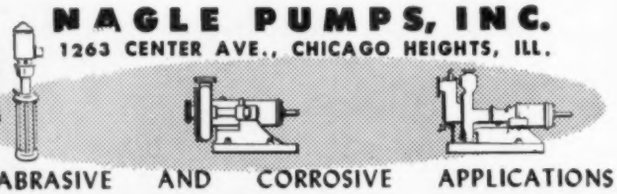
Nagle Vertical Cantilever Pumps eliminate stuffing box troubles, pumped materials do not come in contact with bearings, water end parts made of material most suitable for the particular application. Horizontal and vertical shaft types for every abusive service. No wonder Nagles have become so widely used in less than 10 years.

***Get the facts*—Send for Catalog 5206 and names of steel producing users!**

6" type "SW-OB" pump in pit drainage service, fifth cut, J & L Benson Mine, Star Lake, N. Y. . . . one of 10 Nagle Pumps at this operation.

NAGLE PUMPS

NAGLE PUMPS, INC.
1263 CENTER AVE., CHICAGO HEIGHTS, ILL.



PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

Front-panel controls permit preselecting such operating characteristics as arc voltage, sensitivity to arc-voltage fluctuations, and method (retract or high-frequency) of arc starting. Once these conditions are set, the operator simply flips a switch to start the weld. The torch automatically lowers into position, the arc is struck and welding proceeds continuously until the weld is complete. Since none of the operator's attention is required to control the arc, he can supervise the overall operation more efficiently. Better welds are obtained in less time. Moreover, elaborate production jigs are not required, since setups need not maintain such accurate alignment as is normally required for conventional mechanized welding operations.

PACKAGE MILL

▲ To meet the demand for a heavy duty high speed machine—running as fast as 2500 fpm—for processing narrow strip material to thickness and width tolerances as close as plus or minus 0.0001 in., Stanat Manufacturing Co. has developed a rugged "super-precision" two-stand tandem wire flattening mill.

Occupying only 75 sq ft, this "package" machine, a self-contained production facility, comprises two mill stands and a traversing recoiler mounted in tandem with a dancer roll system to maintain constant wire tension. Designed to convert round wire to flat wire, the unit features accurate control of thickness and width tolerances, close control of edge shape, elimination of strip camber, and produces a smooth surface finish.

ALLOY CHAIN

▲ Now being produced by the McKay Co. is a new line of high strength, one to two in. welded alloy chain capable of lifting phenomenal loads. A single branch of the two in. size, for example, has a breaking strength of over one half million lb. The explanation of such tremendous strength lies in the correct balance of four important factors: link design, steel analysis, welding technique and heat treatment of the finished chain.

Identified by the trade name of McKay-U-Loy, this new line of chain is made with a short, narrow link design which results in maximum

How Good COMMUTATOR MAINTENANCE Saves Money

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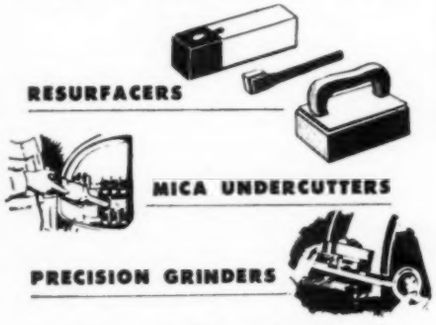

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strength and flexibility. When used around an object, the short links minimize the bending action of each link and reduce the tendency of gouging the chain. The material of the links is a special analysis alloy steel which, after heat treatment, has a tensile strength of 125,000 lb per sq in., with a minimum elongation of 15 per cent and a Brinell hardness of 240 to 280.

The chain derives its name from the distinctive double U method of manufacture in which two U-shaped bars are joined together at the same time by the flash butt welding method.

Because of their high strength, these chains and slings are suitable for all important and critical applications. Because of its high strength per lb, it is also recommended wherever weight is a factor. McKay-U-Loy chain of a given working load limit weighs less than one-half as much as dredge iron chain with the same working load limit. They are also recommended for applications in hot atmospheres when temperatures of 600 degrees to 1000 degrees F are met. Unlike some chains, they need no periodic heat treatment since the alloy steel of which they are made does not work harden in use.

REFRACTORY

▲ Full scale manufacture and production of a new extra strength castable sold under the trade name, Hydrecon 186, Extra Strength is announced by J. H. France Refractories Co.

The new product is intended for iron and steel application where higher compressive strength is required than that afforded by regular 2450 F refractory castables.

Verified laboratory tests results and service reports indicate the new product develops almost twice the cold set strength of standard 2450 F castables at room temperatures. At 2000 F, the product develops over twice the crushing strength of a regular 2450 F castable, according to laboratory reports.

The manufacturer recommends the use of Hydrecon 186, Extra Strength in annealing furnace car bottoms, hood annealing bases, warming or holding pits, door linings, carburetor linings and uptakes and in blow-off linings.

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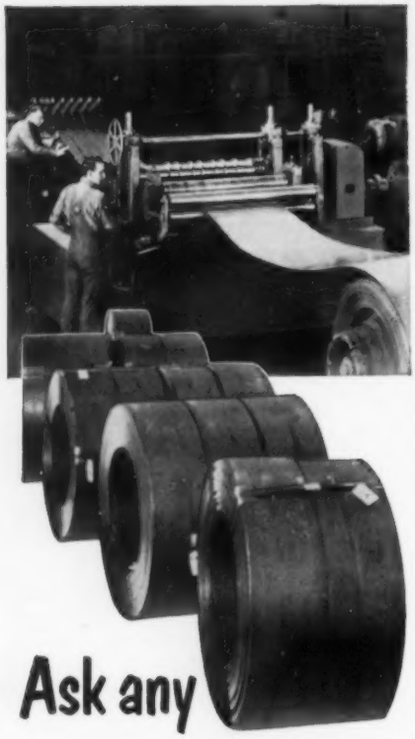

Ask any number of Yoder Slitter Owners—

how they like it, and you may get as many different answers, because the benefits are so many.

One manufacturer said: "Our strip inventories have been reduced by 60% and greatly simplified. Our requirements in slit strands can now be quickly met from a relatively small stock of mill-width coils." Another manufacturer remarked: "We no longer have to worry about ordering strip long in advance, complicating our production planning." A third manufacturer made this comment: "We can now buy our strip wherever we can get the best quality, price and delivery. That saves a lot of time, money and worry."

Any one of these and other benefits may in itself be sufficient to justify the investment; yet, quite aside from this, the *direct savings in slitting cost always repays the investment in a short time,* often in less than a year.

Ask for the Yoder Slitter Book. It contains cost studies, time studies, information on scrap disposal, coil handling, small versus large slitters, and many other subjects of interest to users of coiled strip and sheets.

THE YODER COMPANY
5495 Walworth Ave., Cleveland 2, Ohio

Rotary Gang SLITTERS

ENGINEERING YODER MANUFACTURING

COIL INSULATION

▲ A completely new coil insulation with 50 per cent longer life than conventional systems is now becoming available on General Electric induction motors of 100 to 3000 hp rating, according to the company's Medium Induction Motor Department. Described by G-E engineers as the most significant development in form-wound insulation in 50 years, the new Polyex insulation increases dielectric strength by 50 per cent and mechanical strength by 600 per cent.

For the first time, the materials in an insulation system are natural insulators in themselves, the engineers said. Previous systems have had cotton or paper bases, which in themselves are not insulating materials.

Polyex insulation is the first complete change in large motor insulation since the turn of the century, they pointed out. At that time, the insulation acted only as a spacer to form a dielectric air space between coils. Later improvements included soaking the spacer material in linseed oil, adding insulating materials, and finally the development of cambric cloth, which still utilizes non-dielectric materials.

Heat aging tests of the new insulation show large increases in mechanical and dielectric strength. Resistance to contaminants, shown by salt water immersion tests, is at least twice that of conventional insulation, they said.

In one of the most exacting tests, coil power factor of Polyex insulated coils was substantially lower than coils insulated by conventional systems.

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Book Reviews . . .

"Strength and Resistance of Metals," by John M. Lessells, has recently been published by John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 6 x 9 in., 450 pp., price $10.00. This volume provides the senior and graduate student as well as the design engineer with information on the behavior of metals under stress as it has been revealed by numerous workers in this field. The book fills the gap between determining magnitudes of stresses resulting from external loads and the development of satisfactory designs. Simple engineering rules are given and fundamental aspects of the subject are also presented. It contains 11 chapters which present a thorough and authoritative account of the behavior of metals under stress.

"Metal Processes and Apparatus, Machinery, and Transportation Equipment," a new government publication containing 657 abstracts or brief descriptions of government-owned inventions applicable in these fields, was announced recently. One of a series of seven books of patent abstracts prepared from the Index of Inventions maintained by the Government Patents Board, it was published jointly by the U. S. Department of Commerce and the Small Business Administration. The objective of these new publications is to make available in a practical, convenient form, to industry and particularly to small business, the results of government-financed technical research. These government-owned inventions are ordinarily available to the public on a royalty-free basis.

This new publication includes the title and number of the patent, name of the inventor, the government agency administering the patent, and a list of the addresses of the field offices of the U. S. Department of Commerce and of the Small Business Administration which may be consulted concerning the availability and use of these inventions.

The new book (Order No. PB 111-467) may be purchased at $2.00 a copy from the Office of Technical Services, U. S. Department of Commerce (Room 6227), Washington 25, D. C.

Your best cancer insurance...

"LIFETIME" POLICY... See your doctor *every year* for a thorough check-up, no matter how well you feel.

"DAY-TO-DAY" POLICY ...See your doctor *immediately* at the first sign of any one of the seven danger signals that *may* mean cancer (1) Any sore that does not heal (2) A lump or thickening in the breast or elsewhere (3) Unusual bleeding or discharge (4) Any change in a wart or mole (5) Persistent indigestion or difficulty in swallowing (6) Persistent hoarseness or cough (7) Any change in normal bowel habits.

Many cancers can be cured, but only if properly treated *before* they have begun to spread or "colonize" in other parts of the body.

For *any* information about cancer just call the American Cancer Society or write to "Cancer" in care of your local Post Office.

American Cancer Society

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SLAB HEATER SIDEWALL

Fig. 1 — Picture of Ramtite Side Wall taken after one year service with no maintenance.

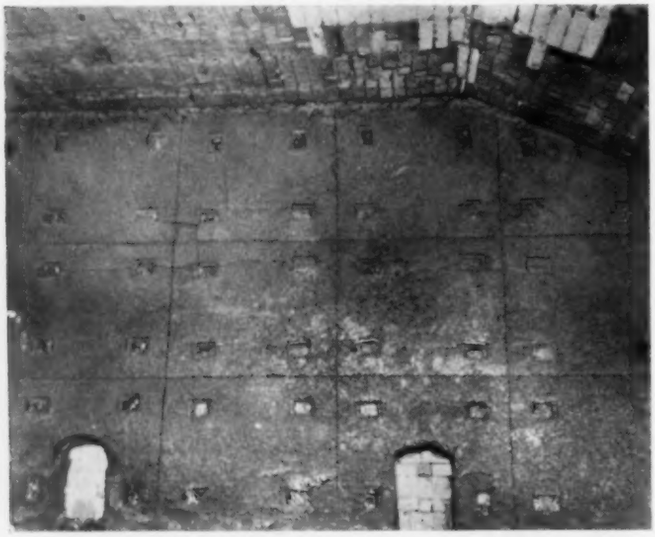

Fig. 2 — The same area as shown in Fig. 1, after three years service with no maintenance.

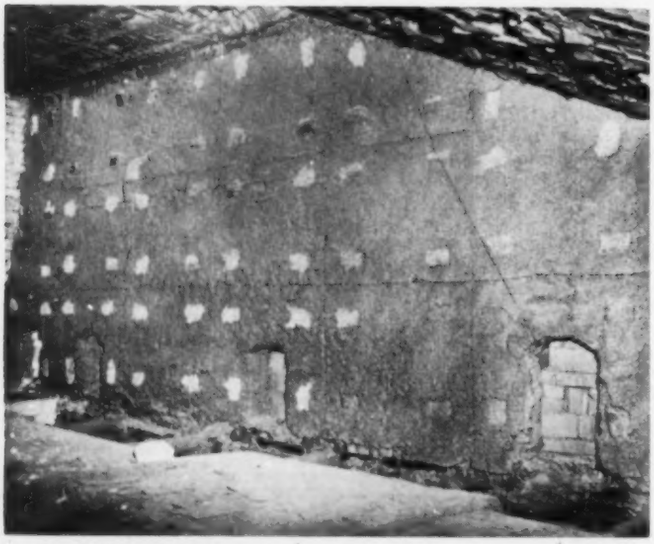

Fig. 3 — Still good after five years service, the only maintenance required has been the filling in the holes left by the spalled anchor ends.

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5 years service

AND STILL IN

GOOD CONDITION

This Ramtite sidewall has paid for itself over and over again with five years uninterrupted, economical service with less than $50.00 maintenance, in the No. 1 Continuous Reheat Furnace, 96" Plate Mill, United States Steel Corporation's South Works, Chicago, Illinois.

Ramtite Plastic Refractory has given outstanding service in this type of application, not only to United States Steel, but also to many other users. The good service record is due partly to the monolithic construction with Ramtite — eliminating joints, cracks and air space. The inherent spall-resistance, Ramtite's natural tolerance toward physical and thermal shock; and the extremely low drying and firing shrinkage found only in Ramtite Plastic Refractory contributed equally to this new service record.

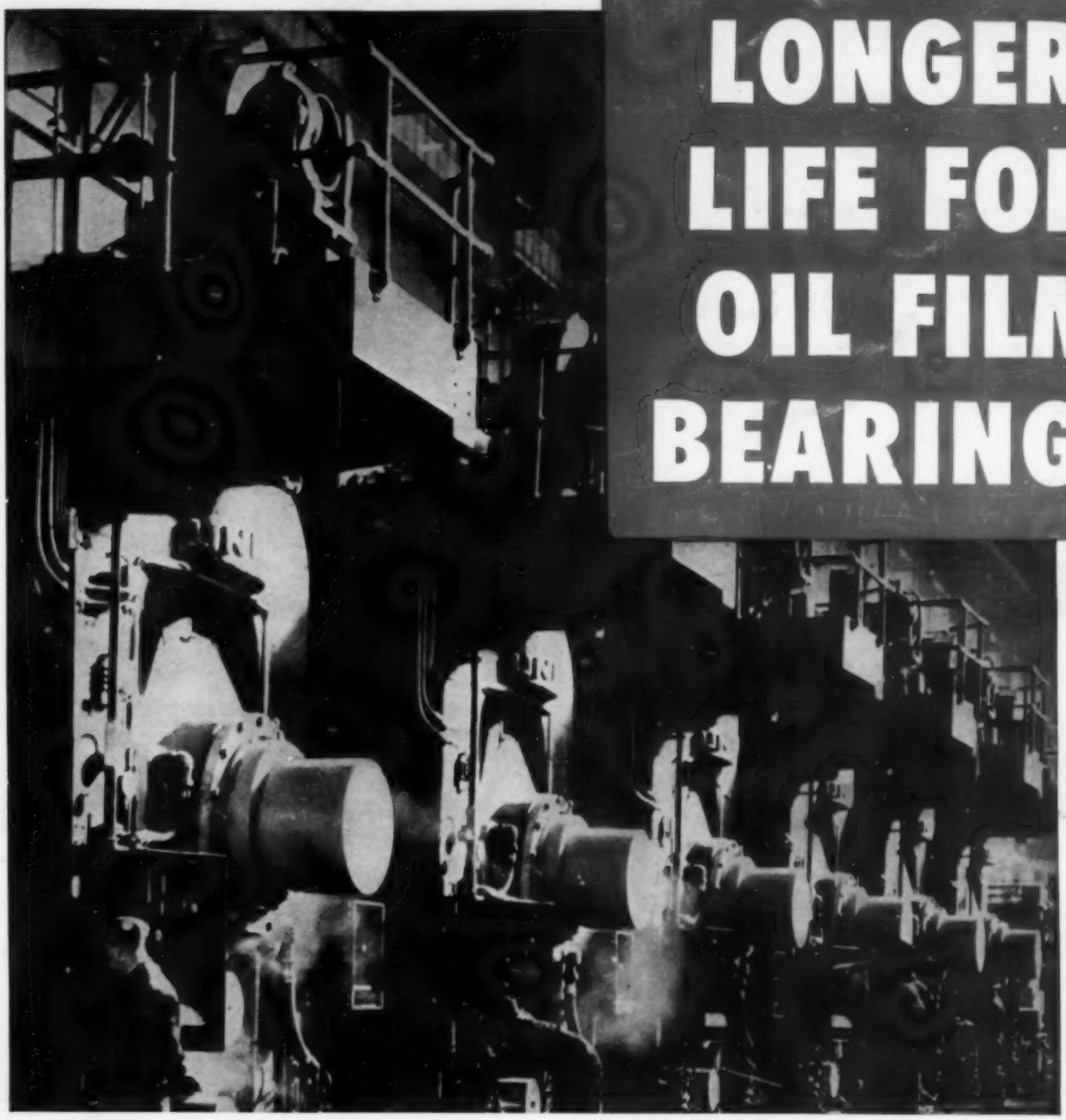
In Continuous Reheat Furnaces, Ramtite can be used for flat roofs, sloping roofs, knuckle noses, burner cones and walls, sidewalls, and door openings, in all zones. Ramtite, used with just one fired shape — the patented SAFE-TIE ANCHOR©, can be used for any or all of the above applications, as well as many others, resulting in a great reduction of your refractory inventory, and a substantial saving in warehouse space.

Here is a simple, painless way to get the answer to your refractory problem: Just contact your local Ramtite man. He's experienced in the refractory field, and he will gladly give you any information or assistance possible.

THE Ramtite CO.

DIV. OF THE S. OBERMAYER CO.

This is another in a series of advertisements depicting ways Ramtite Refractories serve the steel industry.



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Farval protects coiler against ordeal by water, grime, heat and shock

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Studies in Centralized Lubrication
No. 157

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Why not look into Farval today? You may be pleasantly surprised at the savings you make in lubricant consumption, man hours and increased bearing life. Write for Bulletin 26. The Farval Corporation, 3278 East 80th Street, Cleveland 4, Ohio.

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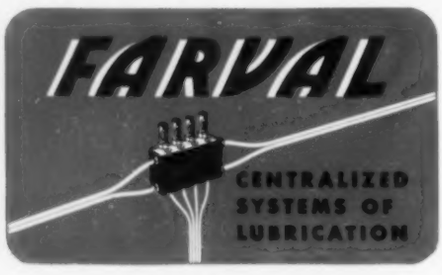

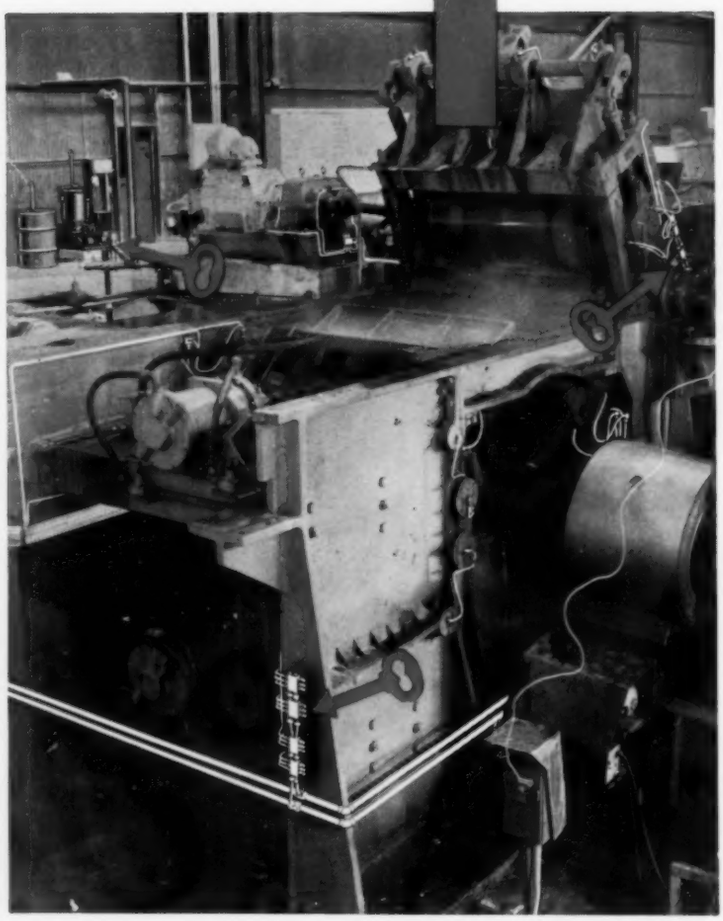

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Photograph above showing a *Farvalized* hot strip down coiler in action by courtesy of United Engineering and Foundry Co.